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From Academic Entrepreneurship to the Performance of Academic Spin-Offs: A systematic Review of the International Gap and the Colombian Context

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ABSTRACT: The advancement of academic entrepreneurship and the establishment of academic spin-offs are fundamental tenets that propel innovation and economic growth on a global scale. Nevertheless, the trajectory of these initiatives exhibits considerable discrepancies between developed and emerging countries, such as Colombia. This study conducts a systematic review of articles indexed in Web of Science, employing the PRISMA protocol to guarantee a rigorous and reproducible selection process. A total of 2,532 articles published between 2014 and 2024 were subjected to a rigorous selection process, resulting in the exclusion of 40 articles that did not meet the pre-defined criteria. The methodology is based on an interpretative paradigmatic view and a subjective study, which are complemented by the visual analysis tool Posit PBC™ for bibliometric analysis in Biblioshyni. The study addresses pivotal questions pertaining to the evolution of research in this field, the factors that determine the success of spin-offs, and the projected trajectory for Colombia in comparison with global trends. The results demonstrate a shift in focus from the initial emphasis on the establishment of spin-offs to a growing emphasis on their performance and long-term sustainability. At the international level, research underscores the significance of technology transfer, university-industry collaboration, and the effective management of technological resources as pivotal factors for the success of these initiatives. Conversely, in Colombia, the majority of studies concentrate on the institutional, cultural, and regulatory aspects that foster the creation of spin-offs, while the analysis of their performance subsequent to establishment is less prevalent.

Keywords: Academic Spin Off, Academic Entrepreneurship, Technology Transfer, University-Industry Relationship, Entrepreneurship Intention,

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1. Introduction

Universities are acknowledged as principal generators of knowledge, and the dissemination of this knowledge to the business sector through spin-offs is a significant contributor to regional economic development (Valmaseda & Hernández, 2012). The interconnection between universities, businesses, and governments is of paramount importance in the genesis of technology-based university spin-offs (Colinas-León et al., 2021). The collaboration of these actors is a key driver of the emergence of spin-offs, both at the individual and joint action levels (Colinas-León et al., 2021). The university-industry-government link facilitates the transfer of knowledge, access to financial and technological resources, and support in

business management (Colinas-León et al., 2021). Nevertheless, despite the multitude of typologies and definitions of academic spin-offs, authors such as Castro-Rodríguez et al. (2020) emphasise that only a handful of studies have provided a comprehensive view that integrates all relevant factors in spin-off creation.

Moreover, the majority of research concentrates on providing a description of these companies at a specific point in time, with a focus on their origins in university research. It is crucial for the development of knowledge-based economies that knowledge transfer from universities is facilitated. The creation of spin-offs through academic entrepreneurship enables the application of knowledge, receiving support from governments and the productive sector. This contributes to economic growth through job creation and the commercialisation of innovations (Civera et al., 2020; Carlsson et al., 2009). Spin-offs serve as conduits for technology transfer between universities and industry, transforming research outcomes into marketable products (Dahlstrand, 2008). They play a pivotal role in regional development by bolstering the local economy (Ndonzuau et al., 2002). In addition to stimulating economic growth, spin-offs serve to enhance the innovative capabilities of universities and firms. Festel (2013) emphasises that they facilitate the transition from research to commercial development, particularly when additional funding is required. Technology transfer offices (TTOs) play a pivotal role in the creation of spin-offs, with their investment levels demonstrating a correlation with the number of spin-offs, though not necessarily with their success rates (Iacobucci et al., 2020).

A number of studies have identified a number of factors that facilitate the success of spin-offs. These include the entrepreneurial intention of researchers, the quality of the university-industry relationship and the effectiveness of technology transfer (O'Shea et al., 2005). The reciprocal engagement between academic institutions and private enterprises is instrumental in fostering innovation. Financial support, particularly through venture capital, grants, and institutional programmes, is vital for the advancement of prototypes and market penetration. Furthermore, the implementation of tax incentives and innovation support policies serves to foster a favourable environment for academic entrepreneurship (Clarysse et al., 2011).

Research questions

The creation of spin-offs is contingent upon academic entrepreneurship, which facilitates the transfer of knowledge and technology from universities to the productive sector. However, there are notable discrepancies in the performance of spin-offs across regions, including Europe, the United States, and Colombia. These discrepancies can be attributed to a range of contextual and structural factors. While European and American universities enjoy robust support infrastructures, including technology transfer offices and favourable government policies, the situation in Colombia is less favourable, with weaker university-industry interaction and limited institutional support for academic entrepreneurship (Aponte & Sanchez, 2024; Wright et al., 2012).

In Colombia, academic spin-offs encounter considerable obstacles, including a dearth of resources and a tendency to prioritize scientific publication over the commercialization of research (Calderón-Hernández et al., 2020). Furthermore, the lack of support policies and economic incentives represents a significant obstacle to the sustainability and competitiveness of these initiatives. These structural and cultural limitations impede the development of spin-offs and their capacity to compete on the global stage. Notwithstanding these obstacles, international evidence indicates that the performance of spin-offs in Colombia could be markedly enhanced through the implementation of appropriate policies, including the reinforcement of innovation ecosystems, the expansion of funding and the establishment of support programmes for entrepreneurial academics.

Furthermore, although research on spin-offs has expanded, it remains fragmented, and a more comprehensive perspective is required. Although the formation of spin-offs has been extensively researched, there is a knowledge gap regarding their subsequent growth and performance (Vega-Gomez, 2020; Mathisen y Rasmussen, 2019). The existing literature emphasises the significance of examining management strategies and university policies, in addition to the organisational performance of spin-offs (Miranda, 2018; Brandi, 2023).

Therefore, the research questions are:

Rq1: How have the principal research interests in the field of academic entrepreneurship and academic spin-off creation and performance evolved over time?

Rq2: What are the principal factors influencing the creation and performance of academic spin-offs, as identified in the literature through an analysis of the annual distribution of academic papers and sources, their associated citations and authors?

Rq3: What is the projected timeframe for the development of academic spin-offs in Colombia, in comparison to global trends in this field?

2. Theoretical Literature review

2.1 Theoretical frameworks for understanding the university agenda for Spin Off Academic

The literature has identified a theoretical-analytical framework between the constructs: (i) Entrepreneurial Intention, (ii) University-Industry Relationship, (iii) Technology Transfer, (iv) Financing, (v) Incentives, each of these elements is fundamental to understand and promote the creation and development of academic spin-offs.

2.1.1. The concept of entrepreneurial intention

Entrepreneurial intention is regarded as a pivotal predictor of prospective entrepreneurial conduct. Ajzen's model of planned behaviour offers a robust theoretical foundation for examining entrepreneurial intentions among university students, underscoring the role of normative, control, and behavioural beliefs in their genesis. This theory has been extensively validated in the field of entrepreneurship. Kautonen et al. (2015) confirmed its relevance and robustness using longitudinal data from Austria and Finland, demonstrating that intentions are the most accurate predictor of planned behaviour, particularly in contexts where such behaviour is infrequent or unpredictable.

Moreover, Krueger et al. (2000) conducted a comparative analysis between the theory of planned behaviour and Shapero's entrepreneurial event model, and concluded that both models are effective in predicting entrepreneurial intentions. Ajzen's theory places emphasis on the perceived personal attractiveness and social norms, whereas Shapero's model emphasises personal desirability and feasibility. This illustrates the versatility of intention-based models in understanding entrepreneurial activity.

Furthermore, studies have indicated that perceptions of self-efficacy and normative beliefs are crucial factors influencing entrepreneurial intentions. Shook and Bratianu (2010) identified a positive correlation between self-efficacy, desirability, and entrepreneurial intention. However, the same study also identified that support from family and friends can have a negative impact on these intentions, indicating the necessity for a more nuanced approach. Moreover, Kautonen et al. (2011) conducted an econometric analysis that corroborates the predictions of the theory of planned behaviour. Their findings indicate that attitude, perceived behavioural control and subjective norms are significant predictors of entrepreneurial intention, as well as subsequent entrepreneurial behaviour.

2.1.2. University-Industry Relationship

The relationship between universities and industry is a crucial factor in the success of academic spin-offs. As posited by Wright et al. (2012), the establishment of effective collaboration and mutual trust between these entities serves to facilitate the transfer of knowledge and innovation, thereby creating an environment conducive to the formation of new technology companies. Such synergy serves not only to reinforce the connections between academia and industry, but also to enhance the practical deployment of knowledge generated within universities.

University-industry collaboration plays an instrumental role in the success of academic spin-offs. As Hayter (2015) observes, the formation of extra-regional social networks, which encompass non-academic contacts such as investors and advisors, enables academic entrepreneurs to gain access to a broader knowledge

base and a greater range of resources, which are crucial for the success of their ventures. This contributes to regional economic development by facilitating the commercialisation of technological innovations originating from academic institutions.

Furthermore, collaborative innovation between industry and technology spin-offs has been identified as an important channel for the transfer of disruptive innovations. A study by Hess et al. (2013) at the Swiss Federal Institute of Technology Zurich (ETHZ) revealed that such partnerships can significantly increase the chances of success through a model that fosters the development of innovative technologies.

On the other hand, Rybnicek and Königsgruber (2019) conducted a systematic review of the literature on university-industry collaborations and found that the quality of linkages, the content of collaborations, and institutional openness are factors that influence the success of these initiatives. Their findings suggest that the quality of linkages and the nature of the content of collaborations are more robust predictors of success than the quantity of linkages.Fischer et al. (2018) also analysed university-industry collaborations in innovation systems in developing countries and concluded that the quality of linkages is a stronger predictor of the generation of knowledge-intensive spin-offs than the quantity of linkages. This finding highlights the importance of fostering high-quality collaborations to maximise the impact of academic spin-offs on economic development.

2.1.3. The concept of Technology Transfer

Technology transfer is an essential process that enables the successful commercialisation of innovations developed in universities. Markman et al. (2005) proposed a model that examines how the structures and strategies of university technology transfer offices influence the creation of new firms, emphasising the importance of licensing and intellectual property management. A strategic approach to technology transfer is therefore crucial for the success of spin-offs.

Festel (2013) also highlights the importance of technology transfer in the creation of academic spin-offs, arguing that spin-offs can bridge the gap between research, development and commercialisation of results, especially when additional funding is needed. Spin-offs act as intermediaries in the marketplace of ideas, facilitating the commercialisation of emerging innovations.

Van Norman and Eisenkot (2017) highlight the crucial role of technology transfer offices in the management and commercialisation of intellectual property in universities. These offices are responsible for transforming academic innovations into marketable products through licensing and the creation of start-ups, highlighting the need for effective IP management to facilitate technology transfer.

Lockett and Wright (2005) argue that the resources and capabilities of technology transfer offices are key determinants of the creation of academic spin-offs. Their research shows that investment in IP protection and the business development capabilities of these offices are significantly associated with spin-off success, highlighting the importance not only of resources but also of the specific skills of technology transfer staff.

Siegel et al (2007) highlight the policy and performance implications of university IP commercialisation and suggest that universities and regions should formulate coherent technology transfer and commercialisation strategies to maximise the impact of their activities. Coordination between institutional and government policies is essential to create an enabling environment for technology transfer.

Finally, Domingues et al. (2022) conducted a metadata analysis of systematic reviews of academic spin-offs and found that many studies focused on technology transfer models and the feasibility of protecting academic intellectual property as marketable products. Their analysis suggests that a better understanding of these models could improve the efficiency of technology transfer and promote the success of academic spin-offs.

2.1.4. The concept of funding

Funding is a crucial factor for the viability and success of academic spin-offs. Patzelt and Shepherd (2009) highlight that access to funding reinforces other benefits of policy support, such as reduced administrative

burden and access to non-financial resources. This underlines the need for robust financial support structures.

Furthermore, Soetanto and Geenhuizen (2015) highlight that university networks have a significant impact on the ability of spin-offs to attract innovation funding. Relationships with universities not only bring knowledge and research resources, but also facilitate access to financial capital. The structure of the network, including its size and the strength of the links, has a positive impact on this ability. Lenzer and Kulczakowicz (2021) emphasise that spin-offs should integrate technology and business teams from the outset to maximise their potential to attract investment. While they have access to non-dilutive funding, building relationships with investors and preparing for investment rounds is critical to their success.

Hayter (2015) notes that extra-regional social networks, including non-academic contacts such as investors and advisors, enable entrepreneurs to access a wider resource base, which is crucial for commercialising technological innovation and regional economic development. Munari and Toschi (2011) investigated the bias of venture capitalists towards academic spin-offs and found that the scientific reputation of the university, intellectual property rights and academic-industry collaborations are key factors in accessing funding. Moreover, public venture capitalists consider scientific reputation to be more relevant than private venture capitalists.

Finally, Carlesi et al. (2017) show that academic spin-offs can have a significant impact on local economies through job creation, although they face financial difficulties that can hinder their development. Promoting 'innovation finance' and developing a capital market are essential measures to foster their growth.

2.1.5. The Concept of Incentives

Incentives, both financial and non-financial, are key to promoting academic entrepreneurship. Markman et al. (2004) showed that incentive schemes, including payments to inventors and technology transfer office (TTO) staff, have a significant impact on entrepreneurial activity in universities, motivating researchers to become more involved in commercialising their findings.

Han and Heshmati (2016) found that although commercialisation through technology transfer and incentive rules does not always generate significant revenues, industry-university collaboration can generate financial rewards, highlighting the need for more strategic management of these incentives.

Graff, Heiman and Zilberman (2002) argue that TTOs are important channels linking university research with industrial innovation, increasing licensing revenues and promoting the creation of start-ups based on university technology. However, their economic impact on university budgets remains modest, pointing to the need to strengthen these mechanisms.

Walter et al. (2018) find that financial incentives, both direct and indirect, are important determinants of university researchers' propensity to patent and commercialise their research. They also suggest that policies such as a grace period for patenting and the inclusion of patents in academic performance evaluations can be effective, although their effectiveness varies by discipline and researcher experience.

Gan (2023) examined the relationship between research incentives and commercialisation of results in private higher education institutions and concluded that both financial incentives and academic recognition influence research productivity and TTO effectiveness. This finding highlights the importance of a combination of incentives to maximise the impact of academic research..

3. Methodology

3.1 Importance of systematic review in the field of academic spin offs

A systematic literature review is a methodological approach to the rigorous synthesis of existing evidence on a topic. According to Dixon-Woods et al. (2005), these reviews combine qualitative and quantitative techniques to provide a comprehensive and critical view of the body of research, facilitating the identification of patterns and the understanding of complex phenomena. Robinson et al. (2011) note that a systematic review organises and evaluates evidence, characterising gaps in research through an explicit

framework that identifies reasons such as insufficient, biased or inconsistent information. This holistic approach allows the identification of patterns, gaps and areas of controversy in the existing literature.

In the context of academic spin-offs, the systematic review addresses key questions about the factors that drive academics towards entrepreneurship, the barriers they face in setting up companies, and the critical elements for the success of these initiatives. Hossinger et al. (2020) conducted a systematic review of 193 articles and concluded that individual factors, such as personal motivation and prior experience, have a high explanatory power for the entrepreneurial behaviour of academics. However, they also found that the entrepreneurial process and the success of spin-offs are influenced by factors at micro, meso and macro levels, such as relationships with parent organisations and the regional context.

In addition, the systematic review facilitates the identification of areas requiring further research. Domingues et al. (2022) conducted a metadata analysis of systematic reviews of academic spin-offs and highlighted that, although there are studies that examine empirical and technology transfer models, research on the viability of academic intellectual property as marketable products is still lacking. Such findings are essential to guide future research and policy in the field of academic entrepreneurship.

The systematic review also contributes to practice and policy formulation. Mathisen and Rasmussen (2019) note that such reviews enable the development of conceptual frameworks that integrate diverse research findings on the development, growth and performance of academic spin-offs. Such frameworks can be used by managers and policymakers to design more effective strategies to foster academic entrepreneurship and improve the performance of these firms.

Finally, a well-conducted systematic review ensures greater transparency and replicability in research. Kraus et al. (2022) highlight that these reviews provide a structured and rigorous approach to evaluating and synthesising the existing literature, which is essential to avoid bias and ensure that findings are reliable and valid. This is particularly important in emerging fields such as academic spin-offs, where evidence may be scattered and heterogeneous.

3.2 Data analysis and citation data retrieval

A systematic literature review is a research method that identifies, appraises and synthesises all available research on a specific question or area of study. The aim is to produce a compendium of evidence to support decision-making and the development of future research; this approach provides a comprehensive and critical analysis of articles published in the literature and is essential to identify gaps that need to be filled in practice. The systematic review ensures objectivity and replicability and reduces bias by applying strict and predefined methodological criteria for the selection of studies.

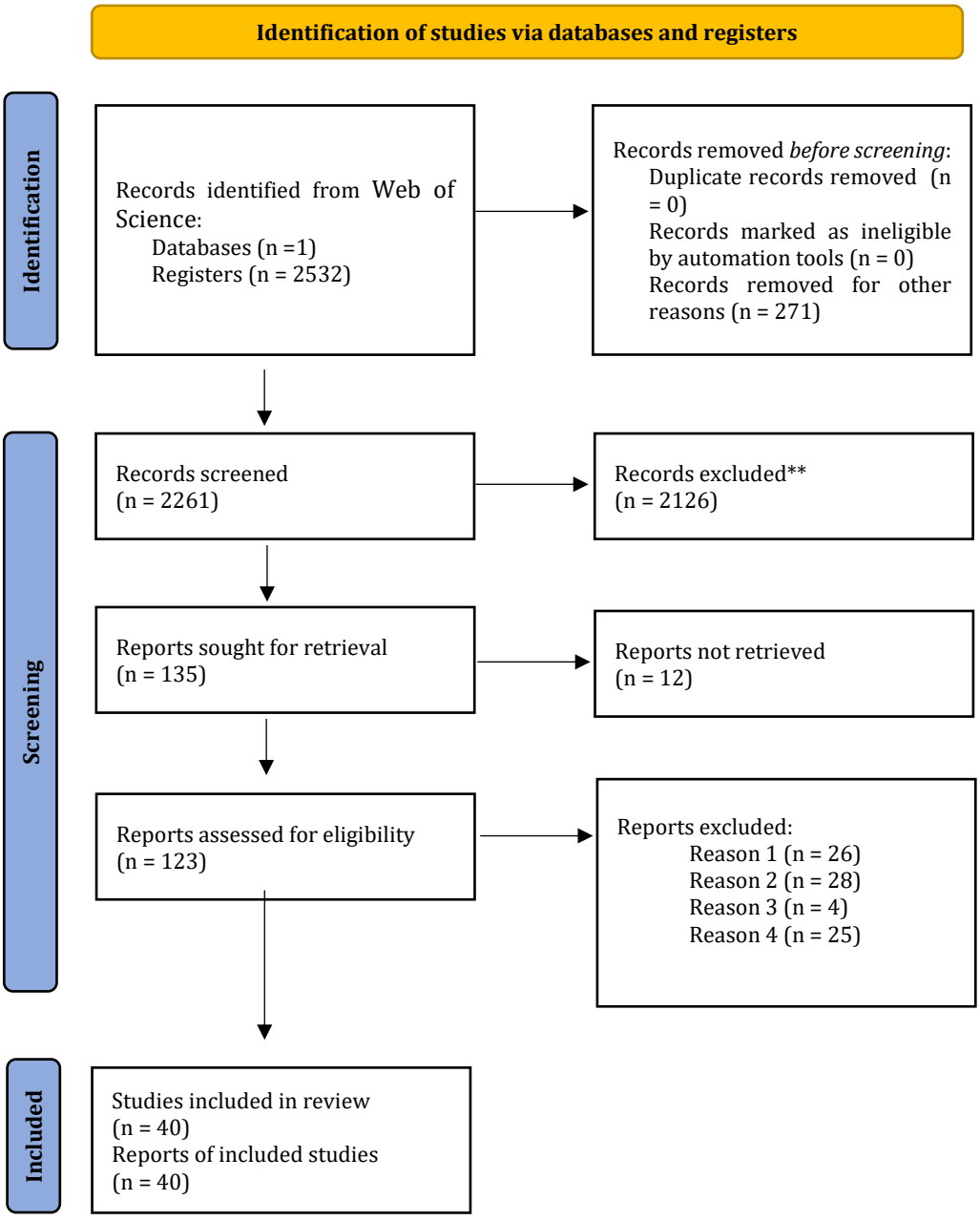
For this review, the Web of Science database was selected rather than combining multiple databases, as the literature has highlighted the complications of multiple databases due to differences in interfaces and codes of each. Bramer (2017) mentions that using multiple databases can be cumbersome, as field codes and proximity operators differ between interfaces. Furthermore, Web of Science is renowned for the quality and accuracy of its indexing of academic publications, which is crucial for obtaining a reliable and representative dataset.

The search was performed using a Boolean equation to capture as many relevant studies as possible in Clarivate Analytics' main citation collection, Web of Science. The equation used was: "Academic spin off" (All Fields) OR "University spin off" OR "Entrepreneurship in public universities" (All Fields) AND "University-Industry collaboration" (All Fields) AND "Third mission of the university" (All Fields) AND "entrepreneurial intention" (All Fields) AND "technology transfer" (All Fields) AND "incentives" (All Fields) OR "ACADEMIC INCENTIVES" OR "rewards" (All Fields) AND "financing" (All Fields) OR "research funding" (All Fields).

The research focused on a systematic review of the literature using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology, which is used to improve the quality of reporting of systematic reviews and meta-analyses by ensuring that it is reported clearly and completely why the review was conducted, what the authors did and what they found (Page et al., 20-21). The search initially

yielded a total of 2,532 articles, but 40 final articles were selected for this study using the stages described below to ensure a rigorous and reproducible evaluation of existing studies. According to Page et al. (2021), the use of the PRISMA statement helps reviewers to report clearly and completely on all aspects of the review process, from the identification of studies to the synthesis of results (see Figure 1).

Figure 1. Diagram of the PRISMA statement and the steps involved in identifying bibliographic data and refining searches. Source: Modified from Haddaway et al. (2020).



Source: Own elaboration

3.3. Criteria for choosing relevant studies

The identification process is fundamental to the PRISMA methodology as it ensures an exhaustive search for relevant studies (Page et al., 2021). In this phase, 2,532 documents were initially identified through a detailed search using a Boolean equation. Complete identification is crucial to avoid selection bias; Delgado-Rodríguez and Sillero-Arenas (2017) highlight that an exhaustive search of databases and manual review of references are essential to minimise this risk and ensure inclusion of all relevant evidence.

It is important to establish clear inclusion and exclusion criteria, develop exhaustive search strategies and apply rigorous appraisal and synthesis methods. This approach not only ensures scientific integrity, but also facilitates the identification and critical analysis of the most relevant and high-quality studies available in the literature.

During the screening phase, a filtering process was carried out to eliminate studies that did not meet certain criteria. In the first screening, 271 papers that were books, chapters or conference papers were excluded, leaving a total of 2,261 papers for detailed assessment. This step is crucial to focus the review on papers that present original research and relevant empirical data.

The second screening focused on excluding papers outside the areas of Management, Business, Business Theory, Economics, and Management Science, reducing the total number to 135 papers and excluding 2,126. This filter ensures that the included studies are directly relevant to the context of entrepreneurship and academic spin-offs, thus maintaining the relevance and focus of the review, as detailed in Table 1.

Table 1. Criteria for the retrieval of cited documents in our data set.

Items	Criteria
Time horizon:	2014-2023
Database:	Clarivate Analytics' Web of Science Core Collection™
Citation Index:	SSCI (Social Sciences Citation Index)
The keywords combination and Booleans/Search Equation†:	"Academic spin off" (All Fields) OR "University Spin Off" OR "Entrepreneurship in public universities"(All Fields) AND "University-Industry collaboration" (All Fields) AND "Third mission of the university" (All Fields) AND "Entrepreneurial intention" (All Fields) AND "Technology transfer" (All Fields) AND "Incentives" (All Fields) OR "ACADEMIC INCENTIVES" OR "Rewards" (All Fields) AND "Financing" (All Fields) OR "Research funding" (All Fields).
Seriation by Web of Science Categories:	Management, Business, Business Theory, Economics, o Management Science.
Quick filters by Web of Science:	Highly cited papers; hot papers; open access; Enriched cited references
Seriation by type of document:	Only original research articles
Software used††:	VosViewer®; Gephi 0.10.1®; Posit PBC™ formerly known as RStudio. It is a rebranding that reflects the expansion into Python and VS Code and its web interface Biblioshiny: the shiny app for bibliometrics.

Source: Own modified from Borges et al. (2022).

3.4. Refined selection criteria

A third screening was performed, excluding 12 non-accessible articles, leaving a total of 123. Open accessibility is crucial so that other researchers can consult and verify the included studies. In the fourth screening, 97 articles that specifically addressed the term "spin-off" were selected, excluding 26 that did not mention it. This step ensures the relevance of the content to the central topic of the review.

The fifth screening focused on temporality, excluding 28 articles published outside the range of 2014 to 2024, resulting in 69 articles. This temporal restriction ensures that the review reflects the most recent and relevant research in the field of academic spin-offs.

The sixth screening verified that the articles included the term "academic spin-offs," selecting 65 and

excluding 4 that did not meet this criterion. This ensures that the studies focus on the specific type of spin-offs relevant to the review. In the seventh screening, 25 articles were excluded that, although they mentioned "academic spin-offs", were not central to their study, determining a total of 40 articles for the systematic review.

For this analysis, we adopted an innovative methodology integrating Bibliometrix®, an R package designed for bibliometric and scientometric analysis, which provides essential techniques for quantitative research (Aria and Cuccurullo, 2017). This tool is compatible with key databases such as Web of Science, Scopus and PubMed, and allows data export in multiple formats.

Following the procedures recommended by Haddaway et al. (2020), we exported the data in BibTex format through the Biblioshiny web interface to ensure its integrity. In our research, we systematically collected and analyzed bibliographic data from peer-reviewed articles in plain text format (.txt). We used Gephi 0.10.1®, a network analysis tool, to process and visualize these data, which revealed the complex underlying structures and dynamics (Romero et al., 2024). Gephi, with its ForceAtlas2 algorithm, facilitates continuous network visualization and is very useful for graphical network manipulation (Jacomy et al., 2014).

4. Results

4.1 Characteristics

The table below classifies the 40 articles reviewed according to their research methodology, providing an overview of the predominant methodological approaches in the study of academic spin-offs. The articles were categorised into seven main types: Mixed (Quali-Quantitative), Quantitative - Descriptive, Quantitative - Other, Qualitative - Case, Qualitative - Interviews, Qualitative - Comparative Analysis and Network Analysis (see Table 2).

Table 2. Number of publications by type of data and research methods applied on 40 foundational studies on USOs

Category	Articles
Mixed (Quali-Quantitative)	4
Quantitative –descriptive	21
Quantitative –other	1
Qualitative –case	10
Qualitative –interviews	1
Qualitative –comparative analysis	2
Network analysis	1

Source: Own elaboration

In terms of distribution, most articles use descriptive quantitative methods, with a total of 21 articles in this category. This approach highlights the prevalence of the use of quantitative data to describe and analyse different aspects of academic spin-offs, e.g. Fernández-López et al. (2020) use the Cox proportional hazards model to analyse how innovation, measured by patenting, and export activities affect the survival of spin-offs. This quantitative approach allows a detailed examination of how these activities affect the longevity of these firms. Similarly, Tagliazucchi et al. (2021) use hierarchical regression analysis to explore the non-linear relationship between founding team composition and the performance of university spin-offs.This study provides an in-depth understanding of how diversity in the academic and non-academic backgrounds of the founding team can affect spin-off growth and success. In addition, 10 articles were categorised as qualitative case studies, indicating a strong focus on in-depth and contextual exploration of individual cases. Authors such as Aaboen et al. (2017) used multiple qualitative case studies to identify the

different roles that university spin-offs can play in business networks. This approach allowed researchers to delve deeper into the dynamics of resource interaction and adapt their findings to different business and regional contexts, providing valuable insights into how these spin-offs can be established and evolve within business networks. Four articles using mixed methods (qualitative-quantitative) were also identified. Dabić et al. (2020), which examines the evolution and future of university spin-offs, uses a mixed approach, combining qualitative content analysis with quantitative multiple correspondence analysis. This combination allowed the authors to map analytical trends and provide a comprehensive reflection on the antecedents, decisions and outcomes of spin-offs over time.

Similarly, Jelfs and Smith (2019) used a mixed method approach in their study of the financial performance of university spin-offs in the West Midlands region. By combining qualitative and quantitative data sources, such as published university accounts and commercial databases, the authors were able to construct a detailed narrative of each spin-off's financial history, providing insights into both its survival and its ability to attract external funding. Other categories include one qualitative article based on interviews, two qualitative comparative analyses, one network analysis and one other quantitative methodology. For example, the study by Visintin and Pittino (2014), classified in the 'Quantitative - Other' category, uses hierarchical regression analysis to investigate how demographic characteristics of founding teams influence the early performance of university spin-offs.

The article by François and Philippart (2016) uses a qualitative interview-based methodology to explore the failure of a university spin-off, highlighting how the legitimation process and the entrepreneurs' strategies influence the initial success of the venture. On the other hand, the studies by Donatiello and Gherardini (2019) and Kwiotkowska (2019) use qualitative comparative analysis to examine the alternative use of university spin-offs in Italy and the financial strategies of Polish spin-offs, respectively, providing valuable insights into how contextual and institutional variations affect these ventures. Finally, the study by Rasmussen, Mosey and Wright (2011) uses network analysis to examine how academic entrepreneurs develop entrepreneurial competencies through the transformation of their social ties, highlighting the importance of networks in the entrepreneurial process. These different methodologies enrich the understanding of academic spin-offs by addressing different dimensions and contexts, providing a comprehensive and multidimensional view of their development and performance.

To answer question Rq1, an analysis was carried out at 3 points in time between (i) 2011-2013, (ii) 2014-2018 and (iii) 2019-2024 to reveal the evolution of concepts related to academic entrepreneurship and the creation and performance of academic spin-offs.

Between 2011 and 2013, the literature on academic spin-offs showed a significant emphasis on entrepreneurship and knowledge transfer; the word cloud reveals prominent terms such as 'knowledge', 'entrepreneurship', to a lesser extent 'performance', 'start-ups' and 'technology transfer', indicating a focus on academics' intentions in the category of entrepreneurship, with an incipient impact on the creation and performance of new academic ventures at the time. Authors such as Wright et al. (2012) suggest that recognising the entrepreneurial behaviour of academics in different contexts is crucial to better understand the economic impact of academic entrepreneurship, pointing out that academic entrepreneurship can occur in a wider range of contexts than previously studied, and suggesting that knowledge transfer policies should be sensitive to individuals and contexts. The keyword frequency figure confirms this trend, showing that 'knowledge' had the highest frequency, followed by 'entrepreneurship', 'performance', 'start-ups' and 'technology transfer'. Other terms such as "academic entrepreneurship" and "academic inventors" were also relevant, underlining the crucial role of knowledge and technology transfer in the development and performance of academic spin-offs during this period, as can be seen in the following graph (see Figure 2).

Figure 2. Word cloud and graph of relevant words for the period 2011-2013

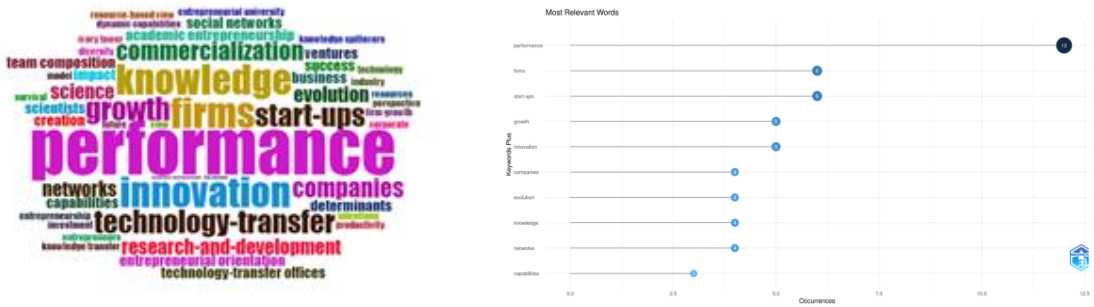
Source: Author's elaboration using the bibliometric tool

Between 2014 and 2018, academic spin-off research focused on several key themes, as seen in the word cloud and related words graph.The terms "performance", "knowledge", "innovation", "firms", "start-ups" and "technology transfer" stand out, reflecting a significant emphasis on firm performance, knowledge management and technology transfer. "Performance" is the most frequent term (14 times), followed by "firms" and "start-ups" (6 times each), "growth" and "innovation" (5 times each) and "firms", "development", "knowledge" and "networks" (4 times each). This indicates a strong focus on understanding the factors that drive spin-off performance and growth, as well as the importance of networks and capabilities for innovation and technology transfer.

In particular, studies by Huynh et al. (2017) and Sternberg (2014) highlight the importance of entrepreneurial capabilities and networks of founding teams in the creation phase of academic spin-offs, as well as the impact of the regional environment and government support programmes on their success. Huynh et al. showed that the entrepreneurial capabilities of founding teams directly influence the future performance of spin-offs, while Sternberg highlighted how the regional context and support programmes can significantly influence the performance of these firms (Huynh et al., 2017; Sternberg, 2014).

These trends suggest that researchers are particularly interested in how spin-offs can optimize their performance through innovation, strategic networks and effective technology transfer, thus consolidating their role in the entrepreneurial and academic ecosystem. This can be observed in the following figure (See Figure 3)

Figure 3. Word cloud and graph of relevant words period 2014-2018.

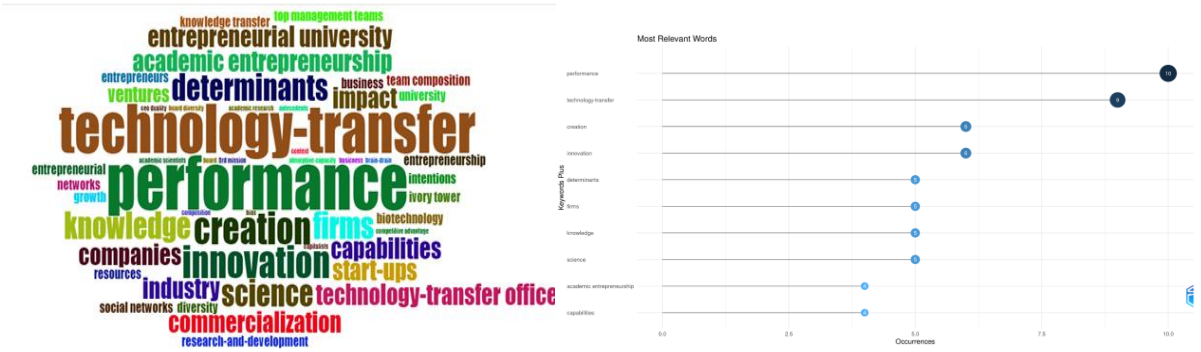


Source: Author's elaboration using the bibliometric tool

During the period from 2019 to 2023, research on academic spin-offs has continued to evolve significantly, the word cloud highlights terms frequently mentioned in the literature of this period, such as “technology-transfer”, “performance”, “knowledge”, “creation”, “innovation”, “firms”, “start-ups”, and “commercialization”, suggesting that research focuses on technology transfer and performance of spin-offs,

with a strong emphasis on knowledge creation, innovation, and commercialization of scientific results (Laage-Hellman et al., 2020; Tagliazucchi et al., 2020). In parallel, the graph of most relevant words shows the frequency of these key terms in the reviewed articles, highlighting “performance” with 12 occurrences, followed by “firms” and “start-ups” with 6 occurrences each, and “growth” and “innovation” with 5 occurrences each, reaffirming the centrality of performance and innovation in spin-offs, as well as the importance of networks and technology transfer for their success and continued development (Fernández-López et al., 2020; Huynh et al., 2020). Taken together, these analyses indicate a continuity in research interests, underlining how to improve performance and foster innovation within academic spin-offs through effective knowledge and technology transfer strategies. This integrative approach suggests that advancing the understanding of the critical factors driving the success of academic spin-offs not only focuses on knowledge creation and transfer, but also on how these entities can optimize their performance and leverage collaborative networks to achieve sustained growth (Berbegal-Mirabent et al., 2020; Ciuchta et al., 2020).

Figure 4. Word cloud and graph of relevant words for the period 2019-2024.



Source: Author's elaboration using the bibliometric tool

In summary, research interests in the field of academic entrepreneurship and the creation and performance of academic spin-offs have evolved from an initial focus on knowledge and entrepreneurship (2011-2013), towards a more comprehensive and diversified understanding of the dynamics of “performance”, “knowledge”, “innovation”, “firms”, “start-ups” and “technology-transfer”, allowing for a more holistic understanding of the factors influencing the success of spin-offs. The centrality of terms such as “research-and-development” and “technology-transfer offices” suggests a focus on the institutional infrastructure and support mechanisms that facilitate the commercialization of academic knowledge (2014-2018); and finally, with the terms "technology-transfer", "performance", "knowledge", "creation", "innovation", "firms", "start-ups", and "commercialization", suggesting that the research focuses on the integration of these elements with an emphasis on the specific determinants and entrepreneurial capabilities that facilitate the success and scalability of spin-offs (2019-2023).

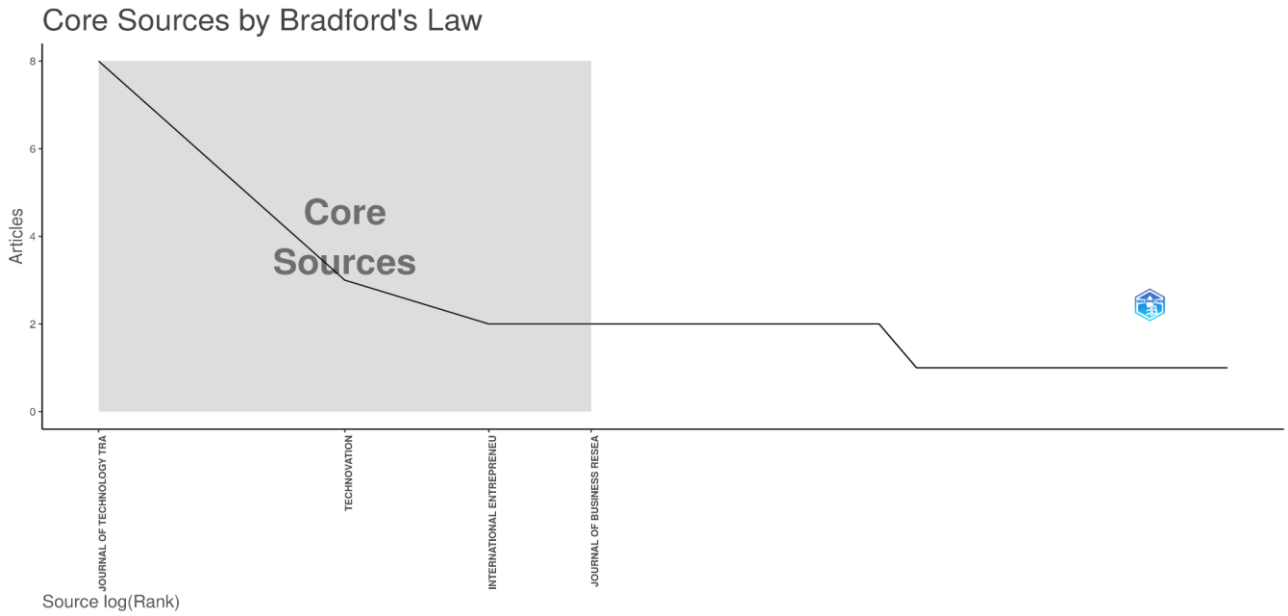
4.2. In order to answer the second research question of this article, called: What are the key factors that influence the creation and performance of academic spin-offs determined in the literature by the annual distribution of academic papers and sources, ¿their associated citations and authors? Bradford's Law was carried out, Number of publications, Temporal development of production (2014-2024), distribution of authors by country, Corresponding authors countries, The most relevant authors in the relationship between creation and performance of academic spin-offs, Production of authors through Lotka's law, Most

cited references and co-occurrence of keywords.

4.2.1 The most relevant sources that apply Bradford's Law of the key factors that influence the creation and performance of academic spin-offs

Bradford's Law, formulated by Samuel C. Bradford in 1934, is a bibliometric theory that describes the dispersion of scientific articles in academic journals. The importance of Bradford's Law lies in its ability to identify the most influential and relevant journals in a given field of study (Egghe, 1990; Brookes, 1969). In the context of academic entrepreneurship and spin-offs, understanding the dispersion of literature through this law allows us to identify the journals with the greatest impact and relevance. From the analysis of the selection of 40 articles on academic spin-offs worldwide, in Figure 5, it can be observed that the distribution of the articles follows the typical Bradford curve, where a small number of highly productive journals (Zone 1) of the Bradford Law concentrates the majority of the relevant articles on the subject. The journals in the core identified are "Journal of Technology Transfer", "Technovation", "International Entrepreneurship and Management Journal", and "Journal of Business Research", with Journal of Technology Transfer, Q1 quartile of quotations and was included in the Social Sciences Citation Index (SSCI) within the Web of Science core collection with an h-index= 102 and Technovation Q1 with an h-index= 159 standing out in this zone.

Figure 5. Core sources by Bradfords' Law and the ten most relevant sources identified in our study.



Source: Author's elaboration using the bibliometric tool

Bradford's Law was applied to a selection of 40 articles on academic spin-offs worldwide, distributing them into two zones according to the frequency of publications in different journals. Zone 1 contains the most productive journals, with the "Journal of Technology Transfer" standing out with 8 articles, followed by "Technovation" with 3 articles, and both "International Entrepreneurship and Management Journal" and "Journal of Business Research" with 2 articles each, accumulating a total of 15 articles (see table 3). This zone represents the key sources that concentrate the largest number of relevant publications. Zone 2 includes journals with a lower frequency of publications, but still significant. Here we find "Journal of the Knowledge Economy", "Research Policy", "Small Business Economics", "Studies in Higher Education", and "Technological Forecasting and Social Change", each with 2 articles, and "Argumenta Oeconomica" with 1 article, adding up to a total of 11 articles in this area (See table 3). The distribution shows that although a small core of journals concentrates the majority of publications, a considerable number of articles are also spread across other sources, evidencing the typical dispersion described by Bradford's Law.

Table 3. Number of publications by type of data and research methods applied on 40 foundational studies on USOs

SOURCE	Rank	Freq	cumFreq	Zone
JOURNAL OF TECHNOLOGY TRANSFER	1	8	8	Zone 1
TECHNOVATION	2	3	11	Zone 1
INTERNATIONAL ENTREPRENEURSHIP AND MANAGEMENT JOURNAL	3	2	13	Zone 1
JOURNAL OF BUSINESS RESEARCH	4	2	15	Zone 1
JOURNAL OF THE KNOWLEDGE ECONOMY	5	2	17	Zone 2
RESEARCH POLICY	6	2	19	Zone 2
SMALL BUSINESS ECONOMICS	7	2	21	Zone 2
STUDIES IN HIGHER EDUCATION	8	2	23	Zone 2
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	9	2	25	Zone 2
ARGUMENTA OECONOMICA	10	1	26	Zone 2

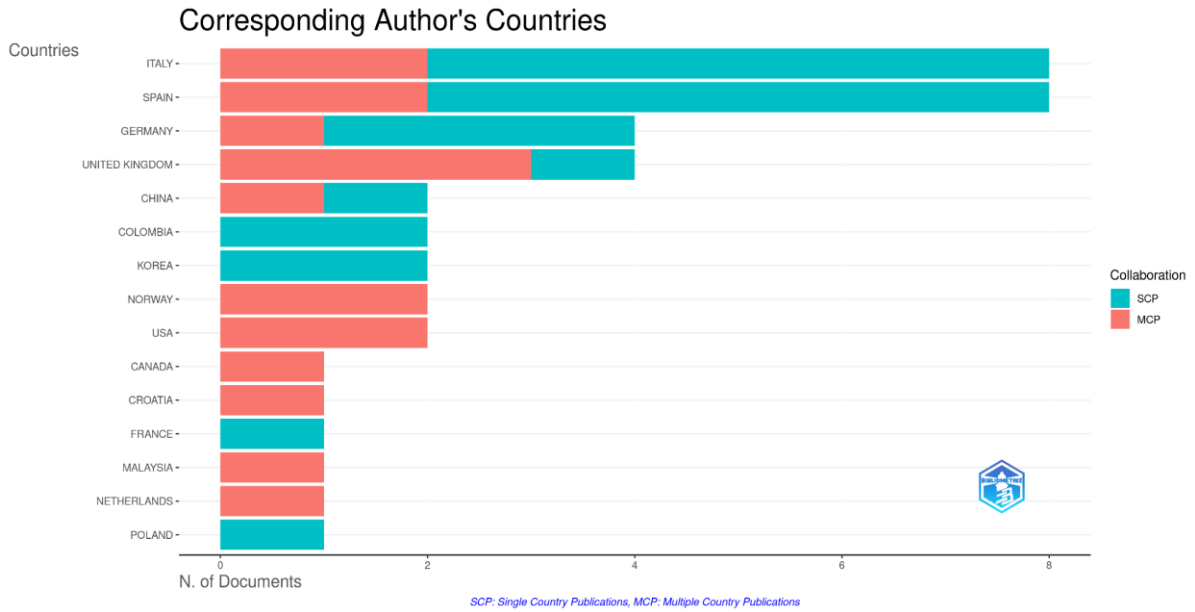
Source: Own elaboration

4.2.2 Time course of output (2014-2024) and distribution of authors by country.

Figure 6 on the country distribution of corresponding authors in publications on academic spin-offs worldwide provides a detailed overview of the key factors influencing the creation and performance of these entities. Italy and Spain lead with 20% of articles each, presenting 75% of single country publications (SCP) and 25% of international collaborations (MCP), highlighting their significant internal capacity to foster research and development of academic spin-offs. Germany and China, with 10% and 5% of articles respectively, show a similar balance between SCP and MCP (see Figure 6), indicating the importance of international collaborations to boost spin-off performance through the exchange of knowledge and practices.

The UK, with 10% of the articles, shows a notable bias towards MCP (75%), underlining the relevance of international collaborations in its research on academic spin-offs. On the other hand, emerging countries such as Colombia and Korea, each with 5% of the articles and 100% SCP, highlight the importance of national policies and local university environments in promoting academic spin-offs. In contrast, Norway, the US and Canada show 100% MCP, reflecting an international collaborative approach crucial to accessing global resources and markets.

Figure 6. Corresponding authors countries

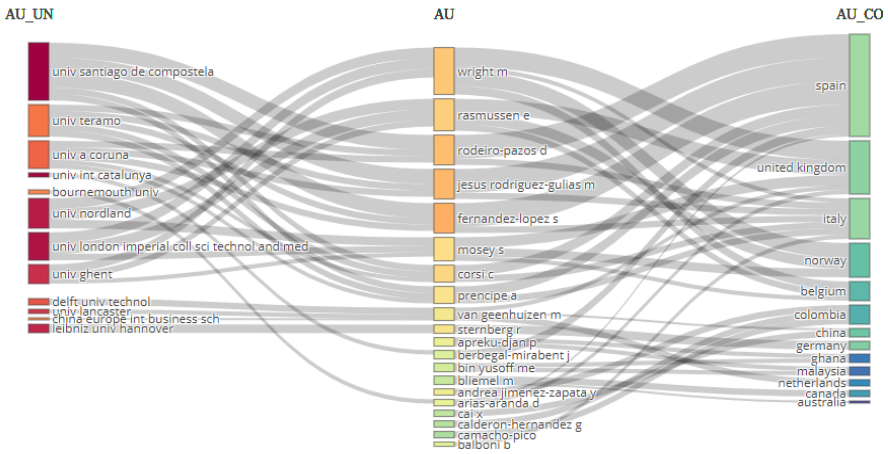


Source: Author's elaboration using the bibliometric tool

These data show that both robust national contexts and effective international collaborations are essential factors in fostering and performing academic spin-offs. The diversity in collaborations suggests the relevance of geographic, institutional, and science policy factors influencing the creation and success of academic spin-offs, highlighting the need for adaptive and collaborative approaches in research and development in this field.

Figure 7, The three field plot, provides a detailed perspective on the interconnections between university affiliations (AU_UN), lead authors (AU), and their countries of origin (AU_CO) in research on academic spin-offs. On the left, institutions such as the University of Santiago de Compostela, the University of Teramo, and the University of A Coruña stand out as major contributors. In the center, prominent authors such as Wright M, Rasmussen E, and Rodeiro-Pazos D (see Figure 7) are linked to multiple universities and countries, evidencing a robust international collaboration. On the right, countries such as Spain, the United Kingdom and Italy emerge as the main contributors in terms of research and publications. This visual representation underlines the importance of transnational and interdisciplinary collaboration in academic spin-off research, highlighting how synergy between institutions and authors from different countries drives the advancement of knowledge in this field. Furthermore, this integrative approach facilitates the exchange of best practices and strengthens the capacity of universities to foster the creation and performance of spin-offs, thus enriching the global ecosystem of innovation and academic entrepreneurship. This holistic view is essential to understand the complex dynamics and global reach of research in this vital area.

Figure 7. Tree plot field about affiliations, authors and countries



Source: Author's elaboration using the bibliometric tool

4.2.3 Distribution of production by country in a period (2014-2024)

The analysis of the production of articles between 2014 and 2024 on the key factors influencing the creation and performance of academic spin-offs reveals a significant contribution from several countries, led by Spain with 32 publications. Italy and the United Kingdom follow with 22 articles each, underlining their strong focus on research and development in this field. Germany also shows a notable presence with 13 publications, while the United States, with 9 articles, and China, with 8, demonstrate their crucial role in the advancement of academic spin-offs. Norway, Belgium and Colombia, with 7 and 6 publications respectively, together with South Korea with 5, complete the top 10 (See Table 4). This distribution pattern highlights the predominance of European countries in research on academic spin-offs, highlighting their commitment to technology transfer and academic entrepreneurship. Furthermore, the presence of the United States and China emphasizes the global relevance of the topic, while the inclusion of Colombia and South Korea indicates a growing interest and development in emerging regions.

In synergy with our previous analyses, this distribution presents a dynamic and interconnected picture of the countries that drive global research excellence in this field of study. This convergence of international efforts not only underlines the importance of global collaboration, but also illuminates how different national contexts contribute to the understanding and success of academic spin-offs, reinforcing the idea that advancement in this field depends on a robust and multifaceted network of academic research and practice.

Table 4. Top 10 list of producing countries over time 2014-2024 for Key factors influencing the creation and performance of academic spin-offs

Country	Frequency of articles published 2014 – 2024
SPAIN	32
ITALY	22
UK	22
GERMANY	13
USA	9

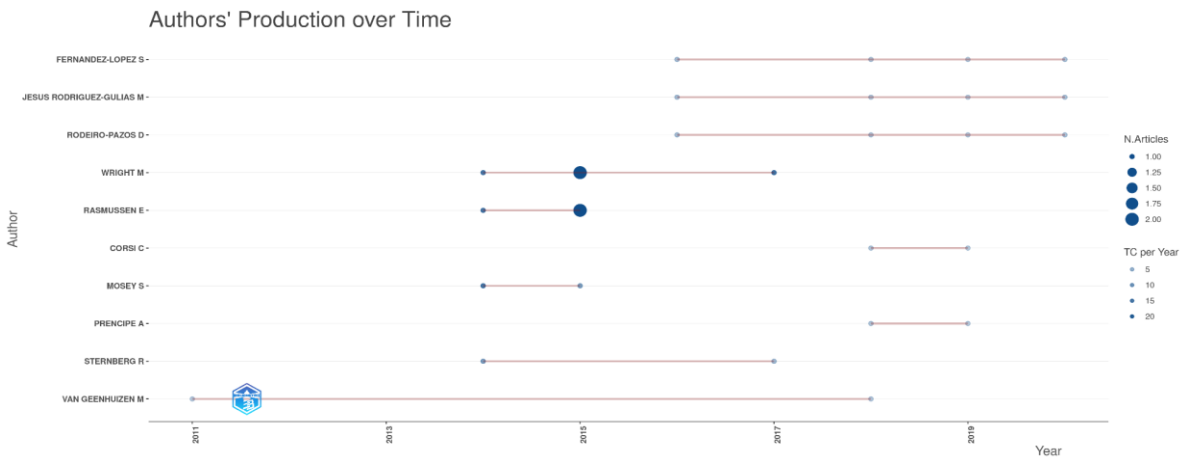
CHINA	8
NORWAY	7
BELGIUM	6
COLOMBIA	6
SOUTH KOREA	5

Source: Own elaboration

4.2.4.The most relevant authors in the relationship between creation and performance of academic spin-offs.

The bibliometric analysis of the production of relevant authors in the field of academic spin-offs, considering figure 8, shows the production of authors over time and provides a comprehensive view of the research dynamics and their evolution, highlighting authors such as Fernandez-Lopez, Rodriguez-Gulias, and Wright have maintained a constant production of articles, especially between 2014 and 2020. In particular, Wright and Rasmussen, are distinguished by their high citation with 165 citations each in 2014, and Wright stands out again with 225 citations in 2015 and 129 in 2017 (see figure 8), reflecting a significant impact on the literature. Authors such as Mosey and Sternberg have also had high productivity and citation in specific periods, with Mosey reaching 165 citations in 2014 and Sternberg with 85 citations in the same year.

Figure 8. Author production over time in the relationship between creation and performance of spin-offs



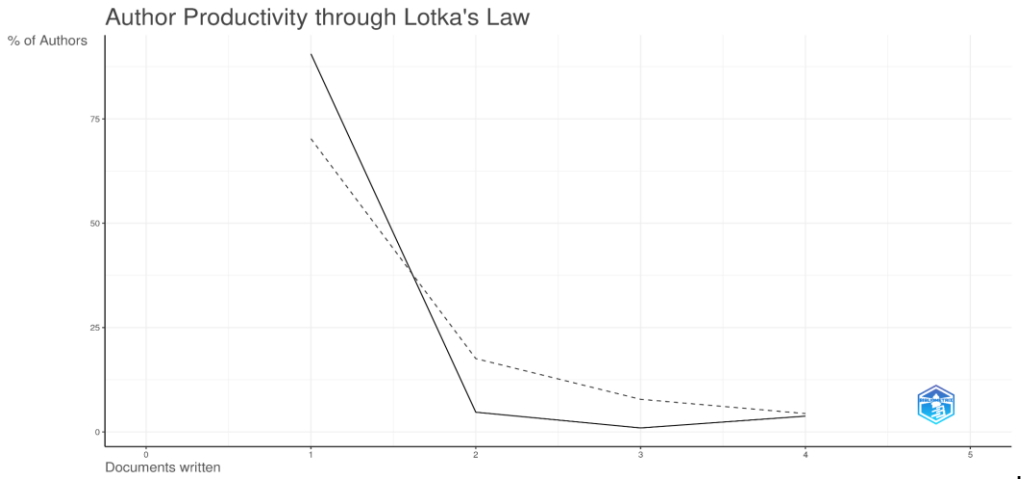
Source: Author's elaboration using the bibliometric tool

This evolution indicates a collaboration and continuity in research on academic spin-offs, highlighting the importance of technology transfer and performance as important categories. The distribution of citations per year is also relevant, showing that authors such as Rasmussen and Wright have a high average of citations per year, suggesting that their works are widely referenced and continue to be influential in the field.

These data not only underline the importance of certain researchers and their contributions, but also the international collaboration reflected in the multiple affiliations and collaborations highlighted in the three-

field plot. Together, these bibliometric analyses not only reveal the evolution and impact of research on academic spin-offs, but also elucidate a clear and holistic picture of a dynamic and interconnected academic community, the obscurity that often surrounds innovation and entrepreneurship processes within academia. This multidimensional approach not only presents a ray of light on various aspects of the phenomenon, but also establishes a solid bridge between theory and practice, thus facilitating the implementation of effective strategies that promote the development of university spin-offs, capable of providing innovative solutions to current and future problems, especially in emerging countries.

Figure 9. Authors' production through Lotka's law



Source: Author's elaboration using the bibliometric tool

Lotka's Law, also known as Lotka's Frequency Distribution of Scientific Productivity, highlights the complex distribution of academic output in a specific field, as explained by Qiu et al. (2017). This metric offers a quantitative perspective to assess the range of output, highlighting the exact number of authors contributing a specific number of publications (Romero et al, 2024).

Lotka's Law, represented in Figure 9 and complemented with the additional data, illustrates the distribution of author productivity in the field of academic entrepreneurship and the creation and performance of academic spin-offs. According to this law, a small number of authors are responsible for the majority of publications, while a large number of authors contribute fewer articles. In the figure, we observe that approximately 90.6% of the authors have written only one paper, 4.7% have written two papers, 0.9% have written three papers, and 3.8% have written four papers (see figure 9). This pattern follows an inverse power distribution, where productivity decreases significantly with increasing number of papers written.

Correlating these findings with the most prolific authors in the supplementary table, it stands out that authors such as Rasmussen E., Mosey S., Wright M., and Fernández-López S (see figure 8) have significant output with high impact. These authors are among the few who defy the general trend observed by Lotka's Law, being responsible for a disproportionately high amount of scientific output.

This high concentration of scientific output in a few highly productive researchers is crucial to understand the dynamics of academic output in this field. The validation of Lotka's Law in this context underlines the importance of these key researchers and their role in advancing knowledge and innovation in the field of academic spin-offs.

4.2.5. Most cited references included in our study

The analysis of the most cited articles in our systematic literature review on academic entrepreneurship

and academic spin-off performance reveals the preeminence of key research in the field, highlighting significant and broad-based contributions. Rasmussen's (2014) and (2015) articles stand out with multiple highly cited publications in journals such as Research Policy, Journal of Technology Transfer and Entrepreneurship & Regional Development, underlining their continued influence and focus on academic spin-off dynamics. Furthermore, Visintin's (2014) papers in Technovation and Fini's (2017) papers in Small Business Economics Group address critical aspects of technology transfer and spin-off performance. The repeated appearance of Sternberg (2014) also in Technovation and of Berbegal-Mirabent (2015) in the Journal of Business Research reflects the diversity of methodological and contextual approaches in the study of academic entrepreneurship. Finally, the analysis includes recent works such as that of Fuster (2019) in Technological Forecasting and Social Change, (See Table 5) indicating the continuous evolution and the growing interest in the future implications of academic spin-offs.

Table 5. Most cited references included in our study

Paper	DOI	Total Citations
RASMUSSEN E, 2014, RES POLICY	10.1016/j.respol.2013.06.007	165
VISINTIN F, 2014, TECHNOVATION	10.1016/j.technovation.2013.09.004	155
RASMUSSEN E, 2015, J TECHNOL TRANSF	10.1007/s10961-014-9386-3	146
FINI R, 2017, SMALL BUS ECON GROUP	10.1007/s11187-016-9779-9	129
STERNBERG R, 2014, TECHNOVATION	10.1016/j.technovation.2013.11.003	85
RASMUSSEN E, 2015, ENTREP REG DEV	10.1080/08985626.2015.1070536	79
BERBEGAL-MIRABENT J, 2015, J BUS RES	10.1016/j.jbusres.2015.06.010	73
FUSTER E, 2019, TECHNOL FORECAST SOC CHANG	10.1016/j.techfore.2018.10.020	60
CZARNITZKI D, 2014, SMALL BUS ECON GROUP	10.1007/s11187-013-9538-0	47
THANH HUYNH TH, 2017, J BUS RES	10.1016/j.jbusres.2017.04.015	40

Source: Own elaboration

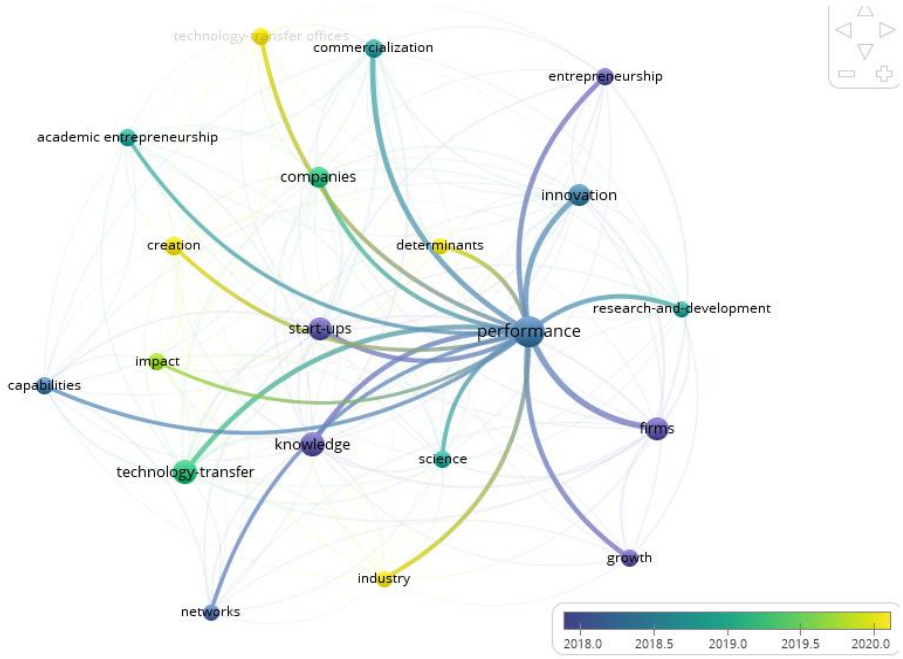
4.2.6. academic entrepreneurship to academic spin-off performance of the co-occurrence keywords

After generating the network of co-occurrence keywords, we use the visualization timeline function overlaying the 2018-2020 timeline in the dashboard, then, we obtain the final timeline map containing nodes, links, and a color bar.

The co-occurrence of terms based on Keywords Plus reveals the relationships between key concepts in academic entrepreneurship research and academic spin-off performance. The central node, "performance," is the most prominent term (see Figure 10), indicating its fundamental importance in the field. This term connects with other crucial concepts such as "innovation," "research and development," "firms," "growth," and "start-ups." These connections underline that the performance of academic spin-offs is intrinsically linked to the ability to innovate and carry out R&D activities.

Furthermore, nodes such as "technology transfer", "knowledge" and "networks" are closely linked, highlighting the importance of knowledge transfer and network collaboration for the success of spin-offs. Terms such as "entrepreneurship", "academic entrepreneurship" and "commercialization" are also present, underlining the relevance of commercializing academic research and creating an entrepreneurial ecosystem that fosters spin-off performance and growth. Similarly, innovation and technology transfer are interrelated, emphasizing the complexity and multidimensionality of research in the field of academic entrepreneurship and spin-offs. This analysis confirms the transition and connection based on academic entrepreneurship and highlights the performance of academic spin-offs as a contemporary focus, pointing out the need for integrated approaches that range from creation to commercialization and sustainable growth.

Figure 10. From entrepreneurship to performance of academic spin-offs, co-occurrence of key words.



Source: Author's elaboration using the VosViewer

In order to answer the second research question of this article, called: What are the key factors that influence the creation and performance of academic spin-offs determined in the literature by the annual distribution of academic papers and sources, ¿their associated citations and authors? Bradford's Law was carried out, Number of publications, Temporal development of production (2014-2024), distribution of authors by country, Corresponding authors countries, The most relevant authors in the relationship between creation and performance of academic spin-offs, Production of authors through Lotka's law, Most cited references and co-occurrence of keywords.

5. Discussion

To answer the last question Rq3: What is the horizon suggested by the literature on academic spin-offs in Colombia compared to global trends on the concept?, we will begin with the evolution of the trend topics and factor analysis of clusters in the world, using a Conceptual Structure Map based on the MCA method, then we will make the comparison with Colombia.

5.1 Factor analysis of clusters in the world

In the factor analysis resulting from the systematic literature review that began with 2532 and after the application of rigorous selection criteria, 40 papers remained, of which four main clusters are identified that group terms associated with research in entrepreneurship and university spin-offs. The green cluster, which includes terms such as "firm performance", "resource based view" and "technology" (See figure 11), highlights the importance of technological resources and corporate capabilities in business performance. This cluster reflects a significant concentration of research on the study of the resource base and its impact on performance, suggesting that this is an area of current interest and well established in the literature.

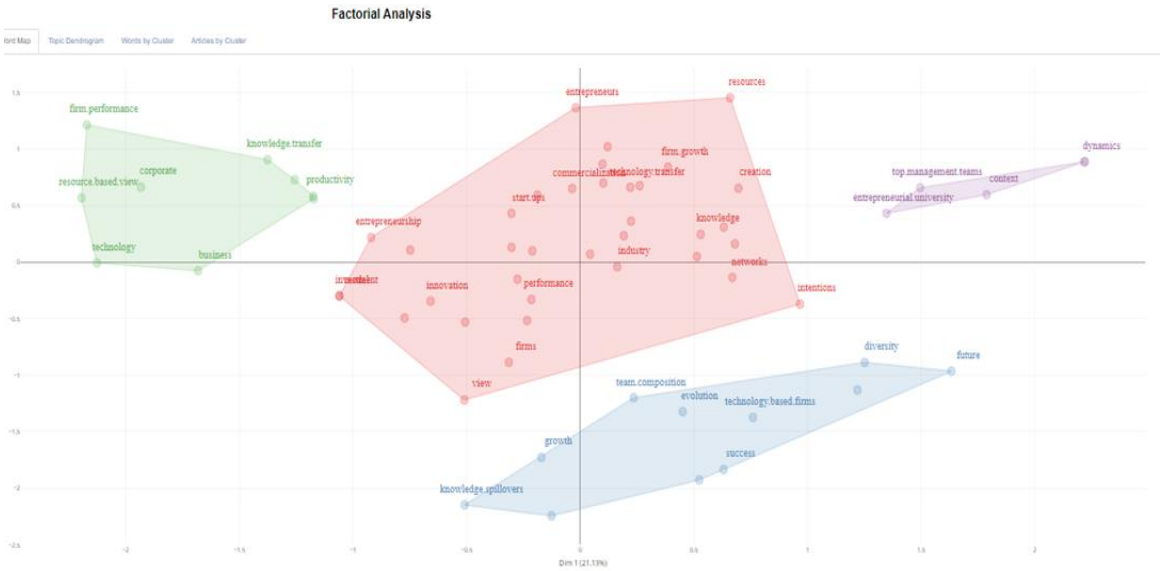
On the other hand, the red cluster groups terms related to "entrepreneurship", "firms", and "start-ups" (see figure 11), indicating a strong focus on the entrepreneurial process and the creation phase of new companies. This cluster suggests that entrepreneurship and the management of the early stages of a company's development are areas of intense attention, probably due to their relevance to economic growth and technological innovation.

The blue cluster focuses on "team composition", "growth", and "success" (see figure 11), highlighting research on the internal dynamics of companies and how these contribute to business success and growth. The presence of this cluster indicates a concern for understanding the human and structural factors that determine the success of start-ups.

Finally, the purple cluster includes terms such as “entrepreneurial university”, “diversity”, and “future” (see Figure 11), suggesting an emerging interest in the role of universities in the entrepreneurial ecosystem and how diversity can influence long-term outcomes. This cluster could be pointing towards potentially underrepresented areas in current research, especially regarding diversity and its impact on innovation and entrepreneurship.

From a future research perspective, the clusters suggest that while areas such as entrepreneurship and resource effectiveness are well covered, topics such as the influence of diversity and the role of universities as innovation incubators could benefit from further exploration. Furthermore, the interaction between universities and industries in the context of university entrepreneurship remains a rich field for future research, with significant potential to uncover how these linkages can be optimized to enhance technology transfer and commercialization of innovations.

Figure 11. Factor analysis of clusters, based on the MCA method



Source: Author's elaboration using the bibliometric tool

5.2. The evolution of Trends Topics around the world

Figure 12 of Trends Topics allows us to observe how research interests in the field of academic entrepreneurship and the performance of academic spin-offs have evolved between 2014 and 2023. The analysis begins in 2014, where the term "entrepreneurship" stands out as the initial conceptual basis (see figure 12). As we move forward in time, a diversification of topics is observed, reflecting a development in the complexity and depth of the field.

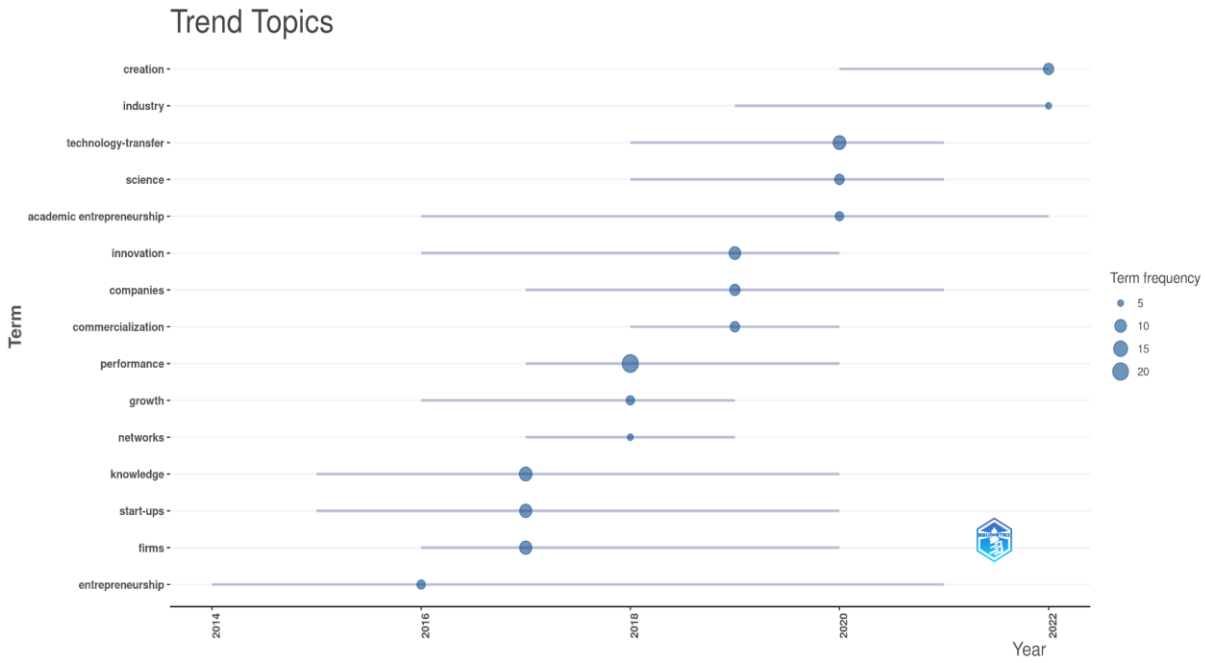
In the initial years, terms such as "academic entrepreneurship" and "technology-transfer" become relevant, indicating a growing interest in how academic institutions can generate new companies and transfer technology to the market. This period also highlights the importance of "science" and "innovation", underlining the connection between scientific research and the creation of new innovative solutions.

As we move into 2016 and 2018, terms such as “knowledge,” “growth,” and “networks” emerge with increasing frequency. This suggests that research is focusing on how knowledge generated in academia can be leveraged for spin-off growth and how collaborative networks can influence their success.

In more recent years, from 2018 onward, terms such as “performance,” “companies,” “commercialization,” and “creation” become prominent. This reflects an increasing focus on spin-off performance, the integration of these new firms into industry, and the commercialization of their innovations. The persistence of terms such as “innovation” and “technology-transfer” (see Figure 12) highlights the continued importance of these processes in the evolution of academic spin-offs.

The evolution of these terms over the years shows a journey from the initial conceptualization of academic entrepreneurship to a more complex and multifaceted approach that includes knowledge, growth, performance, and commercialization. This progression illustrates how the field has matured, adapting to new challenges and opportunities to maximize the impact of academic spin-offs on the economy and society.

Figure 12. Trend topic about spin-off academic



Source: Author's elaboration using the bibliometric tool

5.2. Colombia and the development of scientific literature on academic spin-offs.

In Colombia, the analysis of academic spin-offs has focused on the creation of spin-offs rather than their performance. Of the 14 articles selected for discourse analysis, 4 of them, although with different methodological approaches, have focused on the impact of institutional and governmental policies on the creation of spin-offs, as in the case of Romero Sánchez et al. (2022), who set out to analyse the dynamics of spin-offs in Colombian universities, using a survey methodology in 24 of the 90 universities consulted. Their findings highlight that the strategic orientation of the university is a significant driver of spin-off creation, although no specific research gaps are identified. This study suggests the need to strengthen internal policies as a future line of research, using university management variables and knowledge transfer theories as a theoretical framework.

Likewise, studies such as that of Morales Gualdrón (2024) compared the development of spin-offs in Spain and Colombia using a literature review and case analysis. The findings indicate that Spain shows a superior development due to better institutional support and regulatory framework. The study highlights the need to strengthen policies to promote academic entrepreneurship, suggesting the adaptation of successful international policies as future research, without specifying measurable variables, relying on technology transfer models.

In sequence, the article by Bravo-García et al. (2024) proposed an ideal model of academic spin-off that can be replicated in universities, based on combinations of bibliographic reviews and surveys. They highlight the need for internal policies that improve the research environment, suggesting the importance of institutional support for the success of spin-offs. Their article is based on theories of entrepreneurship and technology transfer.

Flórez and Cardenas (2024) this work identifies key practices and policies that promote the successful creation of spin-offs in Colombia, highlighting the importance of institutional support and the integration of research and innovation, identify key practices and policies for the successful creation of spin-offs in Colombia, highlighting the role of institutional support and the need to integrate research and innovation into a coherent framework that facilitates the transfer of knowledge.

All these studies converge on the importance of institutional support and internal policies as key elements for the success of academic spin-offs. There is a consensus that universities should adopt a more proactive and strategic approach in promoting entrepreneurship and innovation, which implies not only the adoption of solid internal policies but also the integration of successful practices observed in international contexts. This integrative approach suggests a model where collaboration between universities, government and industry, based on the triple helix framework, can be particularly effective in the Colombian context to overcome existing barriers and take full advantage of the potential of academic spin-offs.

In sequence with the above, authors such as Castrillón-Muñoz et al. (2023) share a common approach in promoting academic spin-offs through the triple helix model, which emphasizes cooperation between universities, industry and government. Both articles discuss how institutional support and collaboration structures can be optimized to improve the university entrepreneurship ecosystem in Colombia.

The synergy between these studies lies in their recognition of the value of cross-sector collaboration, as conceptualized by the triple helix model, for the fostering and success of academic spin-offs. While Castrillón-Muñoz et al. (2023) provide a concrete example of how the University of Cauca could lead in this area by utilizing its research and support infrastructure. Both articles suggest that strengthening cooperation between universities, industry, and government can not only help overcome institutional and support barriers, but also maximize the commercial and entrepreneurial potential of university research. These connections highlight the importance of an integrated and collaborative approach to the development of policies and practices that effectively promote academic spin-offs in Colombia.

On the other hand, authors such as Calderón-Hernández et al. (2023) and Jiménez-Zapata and Calderón-Hernández (2023) offer a deeply connected thematic nexus regarding the importance of cultural and institutional factors in the creation of university spin-offs. Both works focus on how cultural barriers and institutional perceptions can influence the ability of universities to foster an enabling environment for entrepreneurship and innovation.

Calderón-Hernández et al. (2023) address institutional barriers in the creation of spin-offs, identifying factors such as university perception, the predominant focus on academic publishing, and lack of incentives as main obstacles. This study raises the need for a cultural change within universities to foster a more entrepreneurial environment.

Jiménez-Zapata and Calderón-Hernández (2023) highlight cultural factors that influence spin-off creation, such as universality, trust, and interdisciplinarity, suggesting that these traits may be critical to fostering an entrepreneurial environment. The study proposes further investigation into how these specific cultural factors can be fostered or enhanced within universities to support spin-off creation, based on a theoretical model that relates organizational culture to spin-off creation.

Both papers underline the importance of addressing and transforming organizational culture within universities to promote increased entrepreneurial and spin-off activity. While Calderón-Hernández et al. (2023) focus on barriers and the need for cultural change, Jiménez-Zapata and Calderón-Hernández (2023) explore how certain cultural attributes can be cultivated to overcome these barriers. Together, these studies offer a comprehensive framework suggesting that to improve the effectiveness of universities as spin-off incubators, not only policies and incentives must be adjusted, but also a profound change in the institutional culture that supports and values entrepreneurship and innovation must be promoted.

Authors such as Castro-Rodríguez et al. (2023) and Naranjo Africano (2011) share a common thread in their approach to improving structures and systems to facilitate the creation and management of academic spin-offs. Both studies highlight the need to research and develop theoretical and practical models that can be adapted to the specific challenges of the Colombian context in terms of academic entrepreneurship and technology transfer. While Castro-Rodríguez and colleagues emphasize the need to understand how

various determining factors interact in different contexts to facilitate or inhibit the creation of spin-offs, Naranjo Africano (2011) proposes the implementation of a viable systems model to improve the management and dynamization of these companies, directly addressing structural and organizational challenges.

On the other hand, Romero-Rueda et al. (2024), although focusing on the role of Higher Education Institutions in promoting technology-based companies, also suggest a link with previous studies in terms of the importance of strengthening institutions as catalysts for economic development. This focus on institutional strengthening and the integration of academic capacities in innovation and entrepreneurship processes resonates with the need to investigate and improve support structures, as discussed by Martinez-Ardila et al. (2023) and Naranjo Africano (2011).

On the other hand, Fernández-López et al. (2020) offers a more focused perspective on the practical application of project management in the creation of spin-offs. Although their approach is more methodological and specific to project management, there is an underlying link with the other studies in the need to adopt structured and well-defined approaches to improve the success of spin-offs. However, the connection is more tangential compared to the other studies, focuses on the integration of management practices in the early stages of spin-offs without going into detail about the theoretical models or broader organizational structures discussed in the other articles (Fernández-López et al., 2020).

In Colombia, the academic literature has shown a notable tendency towards studying the factors that facilitate the creation of academic spin-offs, while there has been relatively less attention towards the analysis of the post-creation performance of these companies. This predominant approach can be attributed to several contextual and methodological reasons. First, the institutional framework and innovation policies in Colombia are still under development, which naturally directs attention towards the initial stages of the entrepreneurial process, that is, the creation of new companies based on academic knowledge (Calderón-Hernández et al., 2020; Reina et al., 2023; Castrillón et al., 2019; Mosquera and Vega, 2021).

5.3. Exploring the Gaps in Research on Academic Spin-Offs: A Global and Colombian Analysis

The global literature on academic spin-offs has evolved significantly, focusing on several key aspects that contribute to the success and sustainability of these companies. A systematic analysis of the literature has identified four main clusters: resources and firm performance, entrepreneurial process, internal dynamics of firms, and the role of universities and diversity (Rasmussen et al., 2014; Visintin and Pittino, 2014; Rasmussen et al., 2015; Fini et al, 2017). These clusters reflect a holistic and multidimensional understanding of the spin-off phenomenon, highlighting the importance of technological resources, early-stage management of entrepreneurship, team composition and growth, as well as diversity and the institutional role of universities (Sternberg, 2014; Rasmussen and Wright, 2015; Berbegal-Mirabent et al., 2015; Fuster et al., 2019).

In contrast, academic production in Colombia has shown a different trend. Most studies have focused on the factors that facilitate the creation of academic spin-offs, with less attention to the post-creation performance of these companies (Calderón-Hernández et al., 2023; Castro-Rodríguez et al., 2020). This approach is partly due to the stage of development of innovation policies and the institutional framework in the country. The Colombian literature highlights the need to understand the institutional and cultural barriers that affect the creation of spin-offs, including the perception of universities and the lack of economic and non-economic incentives for academic entrepreneurship (Calderón-Hernández et al., 2023; Jiménez-Zapata and Calderón-Hernández, 2023). This approach reflects the immediate priorities of the Colombian context, where the foundations for a robust innovation ecosystem are still being established.

The comparison with the global trend reveals significant differences in the areas of research. While at a

global level there has been progress towards a more integrated approach that covers both the creation and performance of spin-offs (Rasmussen et al., 2014; Fini et al., 2017), in Colombia, research is more concentrated on the initial stages of the entrepreneurial process (Sternberg, 2014). This is due to several factors, including the need to strengthen institutional and policy capacities to support academic entrepreneurship (Rasmussen and Wright 2015); (Berbegal et al., 2015). In addition, university-industry collaboration in Colombia is in an emerging phase, which limits the ability of spin-offs to access the resources necessary for their growth and sustainability (Visintin and Pittino 2014).

Globally, research has emphasized the importance of technology-based resources and the ability of firms to manage these resources effectively. In Colombia, however, research has pointed out that universities and other institutions still face significant challenges in creating an enabling environment for academic entrepreneurship. Factors such as academic culture, which rewards publishing over knowledge transfer, and the lack of a robust legal and policy framework (Romero et al, 2024), have been identified as key barriers. These challenges underscore the need for a more strategic and coordinated approach to fostering the creation and growth of academic spin-offs in the country (Castrillón-Muñoz et al., 2023). Furthermore, the global literature has made progress in understanding the internal dynamics of firms, such as team composition and the factors that contribute to business success and growth (Rasmussen et al., 2014; Visintin and Pittino 2014). In Colombia, however, this type of research is less common. Most studies have focused on identifying and overcoming initial barriers to spin-off creation (Romero et al., 2022), with less emphasis on how these firms can grow and thrive once established. This gap in research represents an opportunity for future research that can provide a more complete understanding of the life cycle of academic spin-offs in the Colombian context.

Finally, the interaction between universities and industries is a well-explored field at a global level, highlighting how these links can optimize technology transfer and commercialization of innovations. In Colombia, this area of research is still in development, and effective collaboration between universities and industries is crucial to improve the viability and impact of academic spin-offs. The evolution of research in Colombia could benefit from greater attention to these issues, aligning with global trends to maximize the impact of spin-offs on the economy and society. This will require concerted efforts to strengthen the innovation ecosystem, including more favorable policies, economic incentives, and greater integration of research with market needs (Romero Sánchez et al., 2022; Flórez and Cardenas, 2024).

5.4 Future research agenda

The systematic review of the literature on academic spin-offs has allowed us to identify several future research directions, highlighting key areas that require further exploration to enhance the understanding and effectiveness of these university spin-off ventures.

Several studies suggest the need to further explore the collaborative patterns and networking challenges faced by academic spin-offs, for example, Laage-Hellman et al. (2021) recommend the use of additional case studies to better understand interactive behaviours and networking issues. Similarly, Lise Aaboen and co-workers suggest investigating how university spin-offs (USOs) play roles in regional innovation networks and how these roles are affected by regional characteristics.

Research by Tagliazucchi et al. (2021) highlights the importance of investigating the non-linear relationship between founding team composition and USO performance over time. They suggest identifying the exact tipping point of team heterogeneity that allows the problems associated with moderately heterogeneous teams to be overcome. Furthermore, they suggest investigating how highly heterogeneous teams integrate different cognitive and knowledge domains.

Fernández-López et al. (2020) raise the need to examine the support of parent universities in USO survival

and to extend the analysis to other geographical regions in order to improve the generalisability of the results. They also recommend testing the joint effect of innovation and exports on USO survival using larger samples.

According to Rasmussen et al. (2014), future research should focus on how the university departmental context influences the development of entrepreneurial competencies in spin-offs, and they also suggest investigating mechanisms at the departmental level and how these vary between departments with different research reputations and scientific disciplines.

The studies by Huynh et al. (2017) highlight the need to study a broader sample of university spin-offs to increase the generalisability of the findings, using longitudinal data to better understand the dynamic nature of the relationships between founding team skills, networks and spin-off performance over time. Meanwhile, Rolf Sternberg (2014) suggests investigating person-related factors, such as gender and work experience, and further differentiating the regional environment in terms of government support and spin-off success.

Kwiotkowska (2020) recommends extending the research to a larger number of cases, maintaining a qualitative and in-depth approach, and conducting a broad quantitative analysis to provide statistical consistency to the research. Veltri (2022) and colleagues suggest examining other university governance measures and different aspects of technology transfer beyond spin-offs, and analysing their impact on regional development.

Martínez-Ardila et al. (2023) stress the importance of investigating the generalisability of the results in different countries and regions, as well as exploring the different types of collaboration needed at different stages of the spin-off creation process. They also suggest investigating the role of inter-organisational networks in spin-off creation and the role of intermediaries such as technology transfer offices.

Studies on the financial performance of university spin-offs in specific regions, such as the study by Jelfs and Smith (2019), recommend testing conclusions with larger samples and collecting additional qualitative data to gain a deeper understanding of universities' actions and motivations around spin-off creation. Finally, the study by Taheri et al. (2018) suggests the use of longer timelines to study the temporal dynamics of openness and non-linear trends, as well as investigating the relationship between openness and attracting professional investment capital.

Taken together, these studies highlight the need for multidisciplinary and mixed-method approaches to better understand the different factors influencing the success of academic spin-offs. Future research should focus on integrating theoretical and practical perspectives, validating findings in different contexts, and exploring new variables and methodologies to address the complex challenges faced by these ventures.

6. Conclusions

The systematic analysis of the literature on academic spin-offs reveals a significant evolution in the understanding and approach to the phenomenon. Technological resources and management capacity have been identified as fundamental to the success and sustainability of spin-offs, emphasising the need for a strategic approach to technology transfer and business performance. Furthermore, internal dynamics such as team composition and growth management are crucial; a heterogeneous and well-balanced team is essential to navigate the complexities of academic entrepreneurship.

Studies suggest that the composition and heterogeneity of founding teams have a significant impact on spin-off performance. The diversity of skills and experience among members facilitates the integration of knowledge and adaptation to market changes, which are essential for business success. This finding highlights the importance of fostering a culture of diversity and collaboration within entrepreneurial

teams.

The development of academic entrepreneurship and the performance of academic spin-offs show a significant gap between global practices and results and those observed in Colombia. Globally, an integrated approach from the creation to the performance of spin-offs is highlighted, with an emphasis on technology transfer, continuous innovation and commercialisation capacity. These companies benefit from a robust institutional support environment and public policies that facilitate their growth and sustainability. In contrast, research in Colombia focuses mainly on the early stages of the entrepreneurial process, highlighting the difficulties in consolidating a favourable environment.

Factors contributing to this gap include an academic culture that prioritises scientific publication over knowledge transfer, as well as the lack of a robust legal and policy framework to support spin-offs. University-industry cooperation in the country is still in its infancy, which limits spin-offs' access to essential resources. This situation highlights the need to strengthen institutional and policy capacities to promote academic entrepreneurship in Colombia.

To close this gap, it is imperative that Colombian universities and government institutions adopt a strategic and coordinated approach inspired by international best practices. This includes creating incentives for technology transfer, developing regulatory frameworks that facilitate the commercialisation of innovation, and promoting an entrepreneurial culture that values both research and the practical application of knowledge. Only in this way will it be possible to improve the performance of academic spin-offs in Colombia, align the country with global trends and enhance its capacity to contribute to economic and social development.

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1. References

[1] Aponte, M & Sanchez, S. (2024). Globalization, Human Rights And Colombian Armed Conflict. *Migration Letters*, *21*(S5), 1237-1251.

[2] Aria M, Cuccurullo C. bibliometrix : An R-tool for comprehensive science mapping analysis. J Informetr 2017;11:959–75. https://doi.org/10.1016/j.joi.2017.08.007.

[3] Berbegal-Mirabent, J., Enrique Ribeiro-Soriano, D., & Sanchez Garcia, J. L. (2015). Can a magic recipe foster university spin-off creation? *JOURNAL OF BUSINESS RESEARCH*, *68*(11), 2272–2278. https://doi.org/10.1016/j.jbusres.2015.06.010

[4] Borges, P.; Franco, M.; Carvalho, A.; dos Santos, C.M.; Rodrigues, M.; Meirinhos, G.; Silva, R. (2022). University-Industry Cooperation: A Peer-Reviewed Bibliometric Analysis. Economies, 10, 255. https://doi.org/10.3390/economies10100255

[5] Bradford, S. C. (1934). Sources of information on specific subjects. *Engineering*, 137, 85-86.

[6] Bramer, W.M., Rethlefsen, M.L., Kleijnen, J. *et al.* Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study. *Syst Rev* 6, 245 (2017). https://doi.org/10.1186/s13643-017-0644-y

[7] Bravo-García, S., Benavides-Bustos, J., Wagner-Martínez, M. & Londoño-Cardozo. J. (2019). Perspectivas de las spin-off académicas, como modelo de emprendimiento en las universidades colombianas. Desarrollo Gerencial, 11(1), 131-156. DOI: https://doi.org/10.17081/dege.11.1.3443

[8] Brookes, B. C. (1969). Bradford's law and the bibliography of science. *Nature*, 224(5219), 953-

956.

[9] Calderon-Hernandez, G., Andrea Jimenez-Zapata, Y., & Mauricio Serna-Gomez, H. (2020). Barriers to University Spin-Off Creation in an Emerging Context: An Institutional Theory of Organizations Approach. *MINERVA*, *58*(4), 625–650. https://doi.org/10.1007/s11024-020-09407-4

[10] Carlesi, A., Mariani, G., & Scarfò, A. (2017). ACADEMIC SPIN-OFFS FOR THE LOCAL ECONOMY GROWTH. Corporate Ownership and Control, 14, 350-359. https://doi.org/10.22495/COCV14I2C2P8

[11] Carlsson, B., Acs, Z., Audretsch, D., & Braunerhjelm, P. (2009). Knowledge creation, entrepreneurship, and economic growth: a historical review. Industrial and Corporate Change, 18, 1193-1229. https://doi.org/10.1093/ICC/DTP043.

[12] Castrillón, A.J., Infante, A., Zuñiga, A., Martinez, F. (2019). University Spin-Off: A Literary Review for Their Application in Colombia. Journal of Environmental Management and Tourism, (Volume X, Spring), 1(33): 73-86. DOI:10.14505/jemt.v10.1(33).08

[13] Castrillón-Muñoz, Andrés J., Infante-Moro, Alfonso, Zúñiga-Collazos, Alexander, & Martínez-López, Francisco J.. (2020). Generación de empresas derivadas de base tecnológica (Spin Offs), a partir de los resultados de I+D+i de los grupos de investigación de la Universidad del Cauca, Colombia. *Información tecnológica*, *31*(1), 67-78. https://dx.doi.org/10.4067/S0718-07642020000100067

[14] Castrillón-Muñoz, Andrés José, Infante-Moro, Alfonso, Zuñiga-Collazos, Alexander, & Martínez-López, Francisco José. (2020). Capacities of the Research Groups at UNICAUCA, (Colombia) to Develop Spin-Off-type Undertakings. *Journal of technology management & innovation*, *15*(1), 64-75. https://dx.doi.org/10.4067/S0718-27242020000100064

[15] Castro-Rodríguez, A., Martínez-Ardila, H., Camacho-Pico, J (2020). "Factores determinantes en la creación de Spin-off Universitarias", Aibi revista de investigación, administración e ingeniería, vol. 8, no. 2, pp. 62-75, 2020, doi: 10.15649/2346030X.845

[16] Cho, J. H., & Sohn, S. Y. (2017). Competing risk model for predicting stabilization period of university spin-off ventures. *INTERNATIONAL ENTREPRENEURSHIP AND MANAGEMENT JOURNAL*, *13*(3), 777–796. https://doi.org/10.1007/s11365-016-0422-7

[17] Ciuchta, M. P., Gong, Y., Miner, A. S., & Letwin Chaim and Sadler, A. (2016). Imprinting and the progeny of university spin-offs. *JOURNAL OF TECHNOLOGY TRANSFER*, *41*(5), 1113–1134. https://doi.org/10.1007/s10961-015-9464-1

[18] Civera, A., Meoli, M., & Vismara, S. (2020). Engagement of academics in university technology transfer: Opportunity and necessity academic entrepreneurship. European Economic Review, 123, 103376. https://doi.org/10.1016/j.euroecorev.2020.103376.

[19] Clarysse, B., Wright, M., & Van de Velde, E. (2011). Entrepreneurial Origin, Technological Knowledge, and the Growth of Spin-Off Companies. Journal of Management Studies, 48(6), 1420-1442.

[20] Colinas-León, M., Sánchez, R., Salazar, A. (2021). La Vinculación Universidad – Empresa – Gobierno Para La Creación De Spin-off Universitarias De Base Tecnológica: El Caso De Una Universidad Pública Del Estado De Guanajuato. RANAC, 2(7), 193-204. https://doi.org/10.29393/ran7-6vumr30006

[21] Corsi, C., Prencipe, A., Jesus Rodriguez-Gulias Maria and Rodeiro-Pazos, D., & Fernandez-Lopez, S. (2019). Growth of KIBS and non-KIBS firms: evidences from university spin-offs. *SERVICE INDUSTRIES JOURNAL*, *39*(1), 43–64. https://doi.org/10.1080/02642069.2018.1436703

[22] Czarnitzki, D., Rammer, C., & Toole, A. A. (2014). University spin-offs and the ``performance premium''. *SMALL BUSINESS ECONOMICS*, *43*(2, SI), 309–326. https://doi.org/10.1007/s11187-

013-9538-0

[23] Dabic, M., Vlacic, B., Guerrero, M., & Daim, T. U. (2022). University spin-offs: the past, the present, and the future. *STUDIES IN HIGHER EDUCATION*, *47*(10, SI), 2007–2021. https://doi.org/10.1080/03075079.2022.2122656

[24] Dahlstrand, Å. (2008). University knowledge transfer and the role of academic spin-offs. , 235-254. https://doi.org/10.1787/9789264044104-12-EN.

[25] Delgado-Rodríguez M, Sillero-Arenas M. Systematic review and meta-analysis. Med Intensiva (Engl Ed). 2018 Oct;42(7):444-453. English, Spanish. doi: 10.1016/j.medin.2017.10.003. Epub 2017 Nov 21. PMID: 29169792.

[26] Dixon-Woods M, Agarwal S, Jones D, Young B, Sutton A. Synthesising qualitative and quantitative evidence: a review of possible methods. J Health Serv Res Policy. 2005 Jan;10(1):45-53. doi: 10.1177/135581960501000110. PMID: 15667704.

[27] Domingues, M., Santana, H., Ruzene, D., & Silva, D. (2022). Metadata analysis of systematic literature reviews on academic spin-offs. International Journal for Innovation Education and Research. https://doi.org/10.31686/ijier.vol10.iss7.3815.

[28] Donatiello, D., & Gherardini, A. (2019). All that Glitters is Not Gold: the Surrogate Use of University Spin-Offs. Insights from Italy. *HIGHER EDUCATION POLICY*, *32*(2), 203–226. https://doi.org/10.1057/s41307-017-0079-z

[29] Dorner, M., Fryges, H., & Schopen, K. (2017). Wages in high-tech start-ups - Do academic spin-offs pay a wage premium? *RESEARCH POLICY*, *46*(1), 1–18. https://doi.org/10.1016/j.respol.2016.09.002

[30] Egghe, L. (1990). *Introduction to informetrics: Quantitative methods in library, documentation and information science*. Elsevier.

[31] Epure, M., Prior, D., & Serarols, C. (2016). Assessing Technology-Based Spin-offs from University Support Units. *REGIONAL STUDIES*, *50*(3), 411–428. https://doi.org/10.1080/00343404.2014.921669

[32] Fernandez-Lopez, S., Jesus Rodriguez-Gulias, M., Dios-Vicente, A., & Rodeiro-Pazos, D. (2020). Individual and joint effect of patenting and exporting on the university spin-offs' survival. *TECHNOLOGY IN SOCIETY*, *62*. https://doi.org/10.1016/j.techsoc.2020.101326

[33] Festel, G. (2012). Academic spin-offs, corporate spin-outs and company internal start-ups as technology transfer approach. The Journal of Technology Transfer, 38, 454 - 470. https://doi.org/10.1007/s10961-012-9256-9.

[34] Fini, R., Fu, K., Mathisen, M. T., Rasmussen, E., & Wright, M. (2017). Institutional determinants of university spin-off quantity and quality: a longitudinal, multilevel, cross-country study. *SMALL BUSINESS ECONOMICS*, *48*(2, SI), 361–391. https://doi.org/10.1007/s11187-016-9779-9

[35] Fischer, B., Schaeffer, P., Vonortas, N., & Queiroz, S. (2018). Quality comes first: university-industry collaboration as a source of academic entrepreneurship in a developing country. The Journal of Technology Transfer, 43, 263-284. https://doi.org/10.1007/S10961-017-9568-X.

[36] Flórez, D. H. & Cardenas, L. J. (2022). *Análisis de tendencias: Spin-Offs alternativas para la transferencia de conocimiento en AGROSAVIA*. Recuperado de: http://hdl.handle.net/20.500.12324/39002.

[37] Francois, V., & Philippart, P. (2019). A university spin-off launch failure: explanation by the legitimation process. *JOURNAL OF TECHNOLOGY TRANSFER*, *44*(4), 1188–1215. https://doi.org/10.1007/s10961-017-9648-y

[38] Fu, X. M., Harrison, R. T., & Li, D. F. (2022). Venture capital investment in university spin-offs: Evidence from an emerging economy. *JOURNAL OF CORPORATE FINANCE*, *74*. https://doi.org/10.1016/j.jcorpfin.2022.102197

[39] Fuster, E., Padilla-Melendez, A., Lockett, N., & Rosa del-Aguila-Obra, A. (2019). The emerging role of university spin-off companies in developing regional entrepreneurial university ecosystems: The case of Andalusia. *TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE*, *141*, 219–231. https://doi.org/10.1016/j.techfore.2018.10.020

[40] Gan, Q. (2023). Study on the Relationship between Research Incentive Mechanisms and Research Outcome Commercialization in Private Higher Education Institutions. Frontiers in Business, Economics and Management. https://doi.org/10.54097/fbem.v12i1.13760.

[41] Graff, G., Heiman, A., & Zilberman, D. (2002). University Research and Offices of Technology Transfer. California Management Review, 45, 115 - 88. https://doi.org/10.2307/41166155.

[42] Haddaway NR, Page MJ, Pritchard CC, McGuinness LA. PRISMA2020 : An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. Campbell Systematic Reviews 2022;18. https://doi.org/10.1002/cl2.1230.

[43] Han, J., & Heshmati, A. (2016). Determinants of Financial Rewards from Industry-University Collaboration in South Korea. International Journal of Innovation Management. https://doi.org/10.1142/S1363919616500754.

[44] Hayter , C. (2015). Social Networks and the Success of University Spin-offs. Economic Development Quarterly, 29, 13 - 3. https://doi.org/10.1177/0891242414566451.

[45] Hess, S., Suhrbeer, S., & Siegwart, R. (2013). The Impact of Collaborative Innovation between Established Industry and Academic Technology Spin-offs. Business and Management Research, 2, 1. https://doi.org/10.5430/BMR.V2N3P1.

[46] Hesse, N., & Sternberg, R. (2017). Alternative growth patterns of university spin-offs: why so many remain small? *INTERNATIONAL ENTREPRENEURSHIP AND MANAGEMENT JOURNAL*, *13*(3), 953–984. https://doi.org/10.1007/s11365-016-0431-6

[47] Hossinger, S., Chen, X., & Werner, A. (2020). Drivers, barriers and success factors of academic spin-offs: a systematic literature review. Management Review Quarterly, 70, 97-134. https://doi.org/10.1007/S11301-019-00161-W.

[48] Houweling, S., & Wolff, S. (2020). The influence of scientific prestige and peer effects on the intention to create university spin-offs. *JOURNAL OF TECHNOLOGY TRANSFER*, *45*(5, SI), 1432–1450. https://doi.org/10.1007/s10961-019-09747-8

[49] Huynh, T., Patton, D., Arias-Aranda, D., & Miguel Molina-Fernandez, L. (2017). University spin-off s performance: Capabilities and networks of founding teams at creation phase. *JOURNAL OF BUSINESS RESEARCH*, *78*, 10–22. https://doi.org/10.1016/j.jbusres.2017.04.015

[50] Iacobucci, D., Micozzi, A., & Piccaluga, A. (2020). An empirical analysis of the relationship between university investments in Technology Transfer Offices and academic spin-offs. R&D Management. https://doi.org/10.1111/RADM.12434.

[51] Jacomy M, Venturini T, Heymann S, Bastian M. ForceAtlas2, a continuous graph layout algorithm for handy network visualization designed for the Gephi software. PLoS One 2014;9: e98679. https://doi.org/10.1371/journal.pone.0098679.

[52] Jelfs, P., & Lawton Smith, H. (2021). Financial performance studies of university spin-off companies (USOs) in the West Midlands. *JOURNAL OF TECHNOLOGY TRANSFER*, *46*(6), 1949–1972. https://doi.org/10.1007/s10961-020-09835-0

[53] Jiménez-Zapata, Y.A. y Calderón-Hernández, G. (2023). Factores culturales que inciden en la creación de spin-off universitarias. Un estudio en una universidad pública colombiana. Estudios Gerenciales, 34(148), 320-335

[54] Jung, H., & Kim, B.-K. (2018). Determinant factors of university spin-off: the case of Korea. *JOURNAL OF TECHNOLOGY TRANSFER*, *43*(6), 1631–1646. https://doi.org/10.1007/s10961-

017-9571-2

[55] Kautonen, T., Gelderen, M., & Fink, M. (2015). Robustness of the Theory of Planned Behavior in Predicting Entrepreneurial Intentions and Actions. Entrepreneurship Theory and Practice, 39, 655 - 674. https://doi.org/10.1111/etap.12056.

[56] Kautonen, T., Gelderen, M., & Tornikoski, E. (2011). Predicting entrepreneurial behaviour: a test of the theory of planned behaviour. Applied Economics, 45, 697 - 707. https://doi.org/10.1080/00036846.2011.610750.

[57] Kraus, P., Stokes, P., Tarba, S. Y., Rodgers, P., Dekel-Dachs, O., Britzelmaier, B., & Moore, N. (2022). The ambidextrous interaction of RBV-KBV and regional social capital and their impact on SME Management. Journal of Business Research, 142, 762–774. https://doi.org/10.1016/j.jbusres.2021.12.047

[58] Krueger, N., Reilly, M., & Carsrud, A. (2000). Competing models of entrepreneurial intentions. Journal of Business Venturing, 15, 411-432. https://doi.org/10.1016/S0883-9026(98)00033-0.

[59] Kuma, F. K., bin Yusoff, M. E., & Apreku-Djan, P. K. (2022). A Synthesis of Crowdfunding Concepts in the Ghanaian Context: Crowdfunding Information Challenges in Ghana. *JOURNAL OF THE KNOWLEDGE ECONOMY*. https://doi.org/10.1007/s13132-022-01062-2

[60] Kwiotkowska, A. (2020). ALTERNATIVE COMBINATIONS OF DETERMINANTS CREATING FINANCIAL STRATEGY. THE CASE OF POLISH UNIVERSITY SPIN-OFF COMPANIES. *ARGUMENTA OECONOMICA*, *44*(1), 387–412. https://doi.org/10.15611/aoe.2020.1.15

[61] Lenzer, J., & Kulczakowicz, P. (2021). Fueling Spin-offs: Case Studies of University-based Technology Start-up Funding. Technology & Innovation. https://doi.org/10.21300/21.4.2021.4.

[62] Li, H., Yang, X., & Cai, X. (2022). Academic spin-off activities and research performance: the mediating role of research collaboration. *JOURNAL OF TECHNOLOGY TRANSFER*, *47*(4), 1037–1069. https://doi.org/10.1007/s10961-021-09869-y

[63] Liberati, A., Altman, D., Tetzlaff, J., Mulrow, C., Gøtzsche, P., Ioannidis, J., Clarke, M., Devereaux, P., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. The BMJ, 339. https://doi.org/10.7326/0003-4819-151-4-200908180-00136.

[64] Lockett, A., & Wright, M. (2005). Resources, capabilities, risk capital and the creation of university spin-out companies. Research Policy, 34, 1043-1057. https://doi.org/10.1016/J.RESPOL.2005.05.006.

[65] López, P. (2017). Surgimiento de empresas catalogadas como spin-off universitarias en Colombia, análisis desde la gerencia de proyectos (fase I). Revista EAN, 82, pp. 61-72. https://doi.org/10.21158/01208160.n82.2017.1649

[66] Magomedova, N., Villaescusa, N., & Manresa, A. (2023). Exploring the landscape of University-affiliated venture funds: an archetype approach. *VENTURE CAPITAL*, *25*(3, SI), 317–349. https://doi.org/10.1080/13691066.2022.2163001

[67] Markman, G., Gianiodis, P., Phan, P., & Balkin, D. (2004). Entrepreneurship from the Ivory Tower: Do Incentive Systems Matter?. The Journal of Technology Transfer, 29, 353-364. https://doi.org/10.1023/B:JOTT.0000034127.01889.86.

[68] Markman, G., Phan, P., Balkin, D., & Gianiodis, P. (2005). Entrepreneurship and university-based technology transfer. Journal of Business Venturing, 20, 241-263. https://doi.org/10.1016/J.JBUSVENT.2003.12.003.

[69] Martinez-Ardila, H., Castro-Rodriguez, A., & Camacho-Pico, J. (2023). Examining the impact of university-industry collaborations on spin-off creation: Evidence from joint patents. *HELIYON*, *9*(9). https://doi.org/10.1016/j.heliyon.2023.e19533

[70] Mathisen, M. T., & Rasmussen, E. (2019). The development, growth, and performance of university spin-offs: a critical review. The Journal of Technology Transfer, 44(6), 1891–1938. https://doi.org/10.1007/s10961-018-09714-9

[71] Morales Gualdrón, Silvia Teresa. (2020). Una mirada a la evolución de la creación de spin-offs académicas en países iberoamericanos: los casos de España y Colombia. *Tec Empresarial*, *14*(2), 32-46. https://dx.doi.org/10.18845/te.v14i2.5093

[72] Mosquera, G., & Barbosa, J. (2021). El emprendimiento resultado de investigación: una tarea pendiente en Colombia. , 19. https://doi.org/10.15665/ENCUEN.V19I01.1685.

[73] Munari, F., & Toschi, L. (2011). Do venture capitalists have a bias against investment in academic spin-offs? Evidence from the micro- and nanotechnology sector in the UK. Industrial and Corporate Change, 20, 397-432. https://doi.org/10.1093/ICC/DTQ053.

[74] Naranjo Africano, G., (2011). Spin-off académica en Colombia: estrategias para su desarrollo. Multiciencias, 11(1), 35-43.

[75] Ndonzuau, F., Pirnay, F., & Surlemont, B. (2002). A stage model of academic spin-off creation. Technovation, 22, 281-289. https://doi.org/10.1016/S0166-4972(01)00019-0.

[76] Norman, G., & Eisenkot, R. (2017). Technology Transfer: From the Research Bench to Commercialization. JACC: Basic to Translational Science, 2, 197 - 208. https://doi.org/10.1016/j.jacbts.2017.03.004.

[77] O'Shea, R., Allen, T. J., Chevalier, A., & Roche, F. (2005). Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities. Research Policy, 34(7), 994-1009.

[78] Page, M., McKenzie, J., Bossuyt, P., Boutron, I., Hoffmann, T., Mulrow, C., Shamseer, L., Tetzlaff, J., Akl, E., Brennan, S., Chou, R., Glanville, J., Grimshaw, J., Hrõbjartsson, A., Lalu, M., Li, T., Loder, E., Mayo-Wilson, E., McDonald, S., McGuinness, L., Stewart, L., Thomas, J., Tricco, A., Welch, V., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews.. Journal of clinical epidemiology. https://doi.org/10.1016/j.jclinepi.2021.03.001.

[79] Paola, N. (2013). Spin Off Firms from College Students: The Determinants of Entrepreneurial Intentions. Social Sciences Education eJournal.

[80] Patzelt, H., & Shepherd, D. (2009). Strategic Entrepreneurship at Universities: Academic Entrepreneurs' Assessment of Policy Programs. Entrepreneurship Theory and Practice, 33, 319 - 340. https://doi.org/10.1111/j.1540-6520.2008.00291.x.

[81] Petruzzelli, A. M., & Murgia, G. (2022). The regional impact of spin-offs' innovative activity: unveiling the effect of scientific knowledge and parent university's specialization. *STUDIES IN HIGHER EDUCATION*, *47*(10, SI), 2088–2100. https://doi.org/10.1080/03075079.2022.2122661

[82] Qiu J, Zhao R, Yang S, Dong K. Author Distribution of Literature Information: Lotka's Law. Informetrics, Singapore: Springer Singapore; 2017, p. 145–83. https://doi.org/10.1007/978-981-10-4032-0_6.

[83] Rasmussen, E., & Wright, M. (2015). How can universities facilitate academic spin-offs? An entrepreneurial competency perspective. *JOURNAL OF TECHNOLOGY TRANSFER*, *40*(5), 782–799. https://doi.org/10.1007/s10961-014-9386-3

[84] Rasmussen, E., Mosey, S., & Wright, M. (2014). The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures. *RESEARCH POLICY*, *43*(1), 92–106. https://doi.org/10.1016/j.respol.2013.06.007

[85] Rasmussen, E., Mosey, S., & Wright, M. (2015). The transformation of network ties to develop entrepreneurial competencies for university spin-offs. *ENTREPRENEURSHIP AND REGIONAL DEVELOPMENT*, *27*(7–8, SI), 430–457. https://doi.org/10.1080/08985626.2015.107053

[86] Reina, D., Rapini, M., & Corradi, A. (2023). Motivations for University-Industry Interaction: A Typology of Academic Scientists at the National University of Colombia. Innovar. https://doi.org/10.15446/innovar.v34n92.99300.

[87] Robinson KA, Akinyede O, Dutta T, Sawin VI, Li T, Spencer MR, Turkelson CM, Weston C. Framework for Determining Research Gaps During Systematic Review: Evaluation [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2013 Feb. Report No.: 13-EHC019-EF. PMID: 23487868.

[88] Rodriguez-Gulias, M., Fernandez-Lopez, S., Rodeiro-Pazos, D., Corsi, C., & Prencipe, A. (2018). The role of knowledge spillovers on the university spin-offs innovation. *SCIENCE AND PUBLIC POLICY*, *45*(6), 875–883. https://doi.org/10.1093/scipol/scy018

[89] Rodriguez-Gulias, M., Rodeiro-Pazos, D., & Fernandez-Lopez, S. (2016). The Regional Effect on the Innovative Performance of University Spin-Offs: a Multilevel Approach. *JOURNAL OF THE KNOWLEDGE ECONOMY*, *7*(4), 869–889. https://doi.org/10.1007/s13132-015-0287-y

[90] Romero Rueda, F., Rueda Forero, P., Estevez, F. A., & Barrientos Monsalve, E. J. (2022). LA IMPORTANCIA DE LA CREACION DE LAS SPIN-OFF ACADEMICAS. REVISTA COLOMBIANA DE TECNOLOGIAS DE AVANZADA (RCTA), 2(40), 62-70. https://doi.org/10.24054/rcta.v2i40.2353

[91] Romero Sánchez, A., Aponte García, M. S., López Trujillo, M., y Salcedo Mosquera, J. D. (2023). Spin-offs universitarias en Colombia: análisis desde la investigación, innovación y emprendimiento. Revista Venezolana De Gerencia, 28(No. Especial 9), 832-849. https://doi.org/10.52080/rvgluz.28.e9.51

[92] Romero, A., Perdomo-Charry, G. and Burbano-Vallejo, E.L. (2024) 'Exploring the entrepreneurial landscape of university-industry collaboration on public university spin-off creation: A systematic literature review', *Heliyon* [Preprint]. doi:10.1016/j.heliyon.2024.e27258.

[93] Romero, A., Perdomo-Charry, G. and Burbano-Vallejo. (2024). Academic Spin-offs through the Lens of Pragmatism and Mixed Methods . *EVOLUTIONARY STUDIES IN IMAGINATIVE CULTURE*, 30–67. https://doi.org/10.70082/esiculture.vi.951

[94] Rybnicek, R., Königsgruber, R. (2019). What makes industry–university collaboration succeed? A systematic review of the literature. J Bus Econ 89, 221–250. https://doi.org/10.1007/s11573-018-0916-6

[95] Sciarelli, M., Landi, G. C., Turriziani, L., & Tani, M. (2021). Academic entrepreneurship: founding and governance determinants in university spin-off ventures. *JOURNAL OF TECHNOLOGY TRANSFER*, *46*(4, SI), 1083–1107. https://doi.org/10.1007/s10961-020-09798-2

[96] Sciarelli, M., Landi, G., Turriziani, L., & Tani, M. (2020). Academic entrepreneurship: founding and governance determinants in university spin-off ventures. The Journal of Technology Transfer, 46, 1083 - 1107. https://doi.org/10.1007/s10961-020-09798-2.

[97] Shook, C., & Bratianu, C. (2010). Entrepreneurial intent in a transitional economy: an application of the theory of planned behavior to Romanian students. International Entrepreneurship and Management Journal, 6, 231-247. https://doi.org/10.1007/S11365-008-0091-2

[98] Siegel, D., Veugelers, R., & Wright, M. (2007). Technology transfer offices and commercialization of university intellectual property: performance and policy implications. Oxford Review of Economic Policy, 23, 640-660. https://doi.org/10.1093/OXREP/GRM036.

[99] Soetanto, D. P., & van Geenhuizen, M. (2011). Social networks, university spin-off growth and promises of `living labs'. *REGIONAL SCIENCE POLICY AND PRACTICE*, *3*(3, SI), 305–321. https://doi.org/10.1111/j.1757-7802.2011.01044.x

[100] Soetanto, D., & Geenhuizen, M. (2015). Getting the right balance: University networks' influence on spin-offs' attraction of funding for innovation. Technovation, 36, 26-38. https://doi.org/10.1016/J.TECHNOVATION.2014.10.008.

[101] Sternberg, R. (2014). Success factors of university-spin-offs: Regional government support programs versus regional environment. *TECHNOVATION*, *34*(3), 137–148. https://doi.org/10.1016/j.technovation.2013.11.003

[102] Tagliazucchi, G., Marchi, G., & Balboni, B. (2021). A nonlinear relationship between the team composition and performance in university spin-offs. *TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE*, *172*. https://doi.org/10.1016/j.techfore.2021.121061

[103] Taheri, M., Ye, Q., & van Geenhuizen, M. (2018). University spin-off firms' struggle with openness in early knowledge relationships: in search of antecedents and outcomes. *TECHNOLOGY ANALYSIS & STRATEGIC MANAGEMENT*, *30*(11, SI), 1310–1324. https://doi.org/10.1080/09537325.2018.1459539

[104] Thomas, V. J., Bliemel, M., Shippam, C., & Maine, E. (2020). Endowing university spin-offs pre-formation: Entrepreneurial capabilities for scientist-entrepreneurs. *TECHNOVATION*, *96–97*. https://doi.org/10.1016/j.technovation.2020.10215

[105] Urriago Fontal, J. C., Salcedo Mosquera, J. D., Romero Sánchez, A., & Aponte García, M. S. (2023). Consolidación de procesos investigativos integrando criterios de acreditación en alta calidad educativa y tecnologías en Cauca-Colombia . *Revista De Ciencias Sociales*, *29*(3), 112-123. https://doi.org/10.31876/rcs.v29i3.40701

[106] Valmaseda, O., Hernández, N. (2012). Fuentes De Conocimiento En Los Procesos De Innovación Empresarial: Las ≪i>spin-off</i> Universitarias En Andalucía. Arbor, 753(188), 211-228. https://doi.org/10.3989/arbor.2012.753n1013

[107] Vega-Gomez, F. I., Miranda Gonzalez, F. J., & Perez-Mayo, J. (2020). Analyzing the Effects of Institutional-and Ecosystem-Level Variables on University Spin-Off Performance. *SAGE OPEN*, *10*(2). https://doi.org/10.1177/2158244020931116

[108] Veltri, S., Puntillo, P., & Pierri, F. (2022). Investigating the association between universities' corporate governance structure and the knowledge transfer performance outcomes. *EUROPEAN JOURNAL OF INNOVATION MANAGEMENT*, *25*(6), 1154–1179. https://doi.org/10.1108/EJIM-01-2022-0003

[109] Visintin, F., & Pittino, D. (2014). Founding team composition and early performance of university Based spin-off companies. *TECHNOVATION*, *34*(1), 31–43. https://doi.org/10.1016/j.technovation.2013.09.004

[110] Walter, T., Ihl, C., Mauer, R., & Brettel, M. (2018). Grace, gold, or glory? Exploring incentives for invention disclosure in the university context. The Journal of Technology Transfer, 43, 1725-1759. https://doi.org/10.1007/S10961-013-9303-1.

[111] Wright, M., Mosey, S., & Noke, H. (2012). Academic entrepreneurship and economic competitiveness: rethinking the role of the entrepreneur. Economics of Innovation and New Technology, 21, 429 - 444. https://doi.org/10.1080/10438599.2012.656528